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AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: ADVANCED SQUADRON VT86-AJN

W. Carroll Hixson, Fred E. Guedry, Jr.,

Garry L. Holtzman, J. Michael Lentz, and Patrick F. O'Connell

May 1980

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY

PENSACOLA FLORIDA

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ADVANCED SQUADRON VT86-AJN

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NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
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SUMMARY PAGE

THE PROBLEM

Airsickness in Naval Flight Officer (nonpilot) training squadrons can be considered to be a significant biomedical risk having both direct and indirect influence on the cost of training aircrew personnel. During flight, airsickness can degrade student performance and sometimes necessitate repeat hops to achieve training objectives. Additional dollar costs also result when students attrite because of airsickness, with these costs rising rapidly when the attritions occur late in the training program or even later in fleet assignments. Currently, there are few operational data available to describe either the actual incidence or resulting costs of the airsickness risk in these squadrons, and hence, there is insufficient information available for flight surgeons and medical boards to make decisions concerning disposition of airsick individuals. In addition, validated biomedical tests of motion sickness susceptibility to screen and select aircrew candidates best suited for fleet assignments involving different degrees of motion stress are not yet available.

FINDINGS

A longitudinal study has been initiated of airsickness problems in the basic, advanced, and type-specific fleet readiness (RAG) squadrons comprising the complete Naval Flight Officer (NFO) Training Program. Flight performance data, based upon both instructor and student judgments of airsickness severity, are being collected in these squadrons on an individual-student basis. In addition, a large segment of the study population has been exposed to several prototype laboratory tests of motion sensitivity which will be related to the subsequent flight data. In addition to identifying the incidence and severity of airsickness in the individual squadrons, these flight data will have the potential to serve as operations-based validation criteria for establishing the relative merit of the different components of the laboratory test battery.

This report describes the airsickness experiences of 134 NFO students being trained in Advanced Squadron VT86-AJN to perform various weapon operation and navigation duties. Flight data, based upon 1,833 hops flown by these students, are presented which show that approximately 55 percent of the total population reported being airsick on one or more hops, 28 percent reported vomiting on one or more hops, and 30 percent considered their inflight performance to have been degraded by airsickness on one or more hops. Of the total number of hops flown by the students, airsickness, vomiting, and inflight performance degradation occurred on approximately 8.6, 3.7, and 3.4 percent, respectively, of the total flights. Comparative analyses of the airsickness data collected in this squadron with similar data collected from the same population during basic training indicate that the magnitude of the airsickness problem was significantly less in Squadron VT86-AJN (secondary level of training) as compared with Squadron VT10 (primary level of training). As with the first report of the series, data are also presented which relate the flight performance of this specific subpopulation of the

longitudinal study to their performance on the laboratory tests of motion reactivity.

ACKNOWLEDGMENTS

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INTRODUCTION

This is the second of a series of research reports dealing with a longitudinal study of airsickness in Naval Flight Officer (NFO) students being trained for a variety of nonaviator flight assignments in fleet squadrons. The study, described in detail in the first report (3) of the series, was designed to investigate the incidence and severity of airsickness experienced by a sample of the NFO population on an individual-student basis as they progress through the basic, advanced, and fleet readiness (commonly referred to as RAG) squadrons comprising the NFO training syllabus. The study also relates the airsickness data collected in the flight environment to the performance of the students on a series of motion reactivity tests which were presented to a large segment of the study population prior to their beginning flight training. The long-term objective here is to utilize the inflight airsickness data as validation criteria to measure the relative effectiveness of the motion reactivity tests in identifying, on an *a priori* basis, both those students who are highly susceptible to airsickness and those students who rarely experience the problem. The inflight airsickness data thus serve this test validation function as well as defining the magnitude of the airsickness problem within each training squadron.

This report deals with the airsickness reported by NFO students during training in Advanced Squadron VT86-AJN. These students constituted one of four student groups whose airsickness in basic training (Squadron VT10) was previously reported (3). The layout and format of the statistical tables and figures presented in this report have been selected to closely duplicate the tables and figures of the first report to facilitate reader comparison of the results associated with each squadron.

PROCEDURE

Figure 1 is a block diagram of the different training pipelines followed by NFO students before assignment to the operational flight squadrons. This report deals with the airsickness problem in Advanced Squadron VT86-AJN where NFO students are trained in T39-D and TA-4J aircraft for a variety of nonpilot duties in attack aircraft such as the A6 and EA6 and antisubmarine warfare aircraft such as the S3. At the time the study was initiated, the Squadron VT86-AJN flight syllabus was composed of 14 individual hops, the abbreviated names of which are shown inside the related block within Figure 1. All of the data presented in this report pertain to this specific syllabus, the details of which are outlined in Appendix A. (Midway in the study, the Squadron VT86-AJN flight syllabus was changed and expanded to a total of 18 hops. The airsickness study of this new syllabus will be presented in a subsequent report.)

To document the incidence and severity of airsickness experienced by a student during training, the two-sided questionnaire developed for the initial study (3) was again used. One questionnaire was completed for each hop flown, with separate sections provided for student and instructor evaluations of the student's airsickness reactions. In

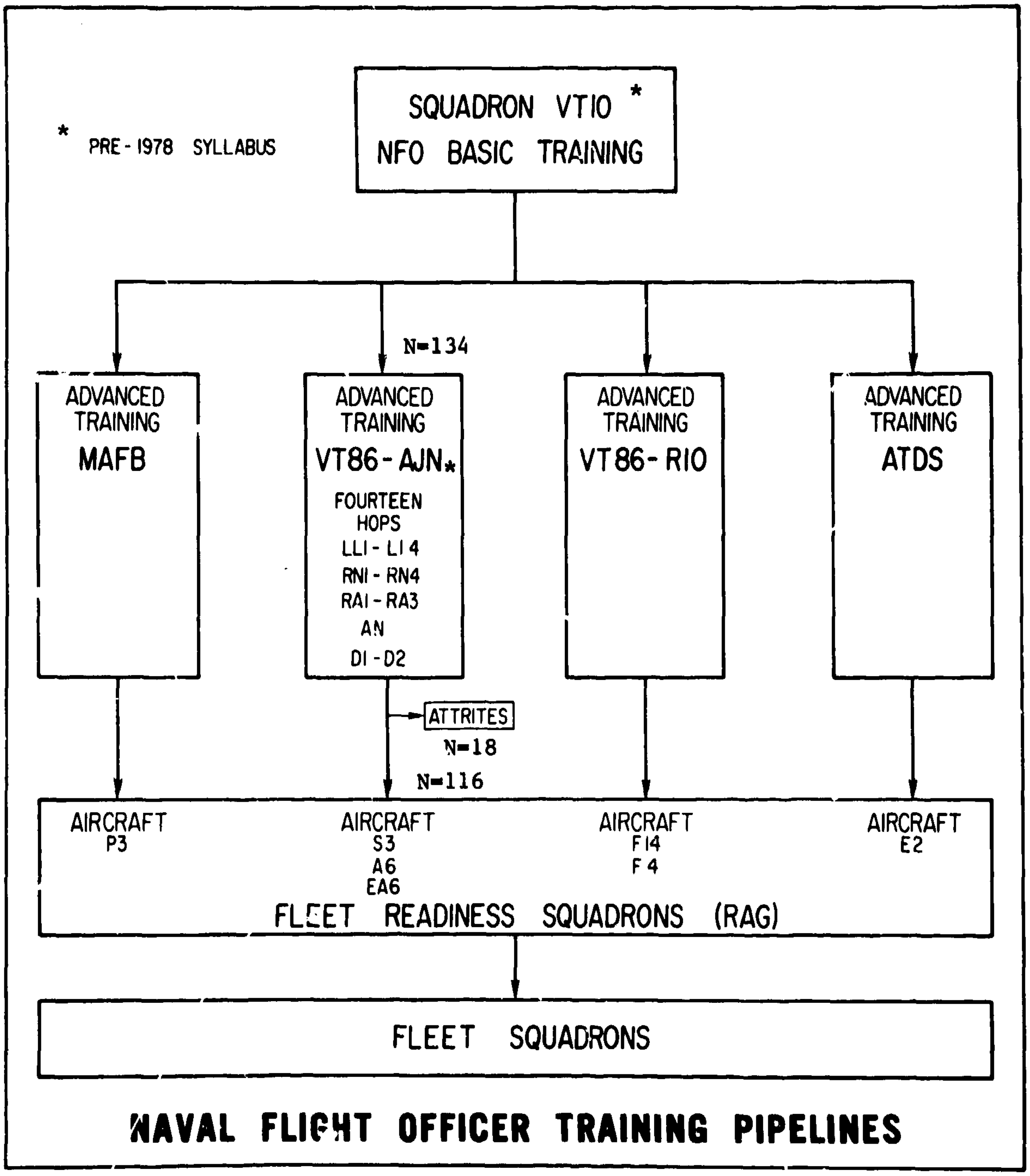

Figure 1

Block diagram showing training pipelines followed by Naval Flight Officer students beginning with basic training and progressing through various advanced and fleet readiness (RAG) squadrons before receiving fleet assignments. This report deals with airsickness incidence in Advanced Training Squadron VT86-AJN.

Figure 2 the student element of the questionnaire is shown at the top, and the instructor element at the bottom. To minimize problems with confidentiality of questionnaire data, the student and instructor sections were printed on opposite sides of the form. By use of a fold line and adhesive tab, the student sealed his responses from view before the instructor completed his side of the form.

The details of the questionnaire have been described in the first report (3) of the series. For the student questionnaire, the key elements were four forced-choice ratings of airsickness experienced during the flight, number of times vomiting occurred, flight performance degradation as a result of airsickness, and any nervousness experienced before or during the flight. A fifth item requested a yes or no answer concerning the use of airsickness medication on the hop. The instructor also provided ratings of the same four airsickness, vomiting, performance degradation, and nervousness parameters rated by the student. In addition, the instructors were asked to similarly rate the roughness of flight; i.e., atmospheric turbulence or pilot technique, encountered on the hop.

The motion reactivity test data presented for the VT86-AJN student population in this report were collected prior to the time the students began their NFO flight training in Basic Squadron VT10. Brief descriptions of these tests are provided in Appendix B, with related references that provide more detailed information on test techniques and procedures. The general methods used in the computer storage of these motion reactivity test data and the related flight airsickness data are outlined in the first report (3) of the series.

RESULTS AND DISCUSSION

A total of 1,833 validated airsickness questionnaires involving 134 VT86-AJN students were collected during this phase of the longitudinal study. As indicated in Figure 1, of the total of 134 students for which flight data were available, 116 (86.6 percent) were graduated from Squadron VT86-AJN and assigned to various fleet readiness squadrons for further training; 18 (13.4 percent) attrited from the squadron before completing training. For the purposes of this study, the attrition total is limited to only those students who attrited after beginning inflight training as marked by the return of one or more completed airsickness questionnaires. Of the total number of attrites, three students dropped out of the program at their own request, one died in an aircraft accident, and the remaining were dismissed from the training program as a result of inadequate academic or flight performance.

The study results are reported and discussed under seven different subheadings. In the first section the data derived from the student and instructor questionnaires are used to define the incidence and severity of airsickness on each of the 14 hops comprising the Squadron VT86-AJN syllabus. In the second section the questionnaire data are discussed in relation to the contribution of students experiencing repeated airsickness to the over-all airsickness incidence figures. In the third section unweighted and weighted airsickness indices are developed on an individual-student basis to quantitatively define the airsickness experiences of

STUDENT FORM	NAMI / NAMRL AIRSICKNESS RESEARCH PROJECT				STUDENT FORM
Student SSN (C 01-09)	Squadron No. (10-13)	Hop No. (14-17)	Julian Date (18-21)	T/O Time (local) (22-25)	
PLEASE ESTIMATE THE FOLLOWING BY MARKING THE APPROPRIATE ANSWER: REPLY TO EACH QUESTION					
AIRSICKNESS (Feeling motion sick whether you vomited or not)	NONE	MILD	MODERATE	SEVERE	26
VOMITING	NONE	ONCE	TWICE	THREE OR MORE TIMES	27
PERFORMANCE DEGRADATION (Due to airsickness)	NONE OR N/A	MILD	MODERATE	SEVERE	28
NERVOUSNESS (Experienced before/during this flight)	NONE	MILD	MODERATE	SEVERE	29
Did you take any medication for airsickness for this flight?	NO	YES			30
T-39 FLIGHTS SHOULD ALSO COMPLETE THE FOLLOWING					
List hops in order flown for this flight	31-34	35-38	39-42	43-46	
Check the box under YOUR hop.					47
If airsick, when did it occur relative to YOUR hop? (Mark more than one box if appropriate)	NOT AIRSICK 48	BEFORE 49	DURING 50	AFTER 51	

FOLD ALONG THIS LINE

INSTRUCTOR FORM	NAMI / NAMRL AIRSICKNESS RESEARCH PROJECT				INSTRUCTOR FORM
NAME OF STUDENT (last name first, initials)					
PLEASE ESTIMATE THE FOLLOWING BY MARKING THE APPROPRIATE ANSWER: REPLY TO EACH QUESTION					
AIRSICKNESS *** (Student appeared motion sick whether he vomited or not)	NONE	MILD	MODERATE	SEVERE	53
VOMITING	NONE	ONCE	TWICE	THREE OR MORE TIMES	54
PERFORMANCE DEGRADATION (Due to Airsickness)	NONE OR N/A	MILD	MODERATE	SEVERE	55
APPARENT NERVOUSNESS (Before and/or during the flight)	NONE	MILD	MODERATE	SEVERE	56
ROUGHNESS OF FLIGHT (Turbulence or pilot technique)	NONE	MILD	MODERATE	SEVERE	57
If this hop incomplete, was airsickness a factor? (Mark more than one box if appropriate)	NONE OR N/A 58	YES This Student Airsick 59	YES Another Student Airsick 60	YES Instructor Airsick 61	
Please record flight grades Example 0 3 for 3	U 62-63	BA 64-65	A 66-67	AA 68-69	
INSTRUCTOR COMMENTS					70
***NOTE TO INSTRUCTOR: Research has shown that some people can feel very sick without vomiting. As a reminder, some of the signs of airsickness are pallor, sweating, heavy breathing, facial expressions, excessive swallowing, drowsiness, and verbal complaints. However, USE YOUR OWN JUDGEMENT.					

Figure 2

Student (top) and instructor (bottom) airsickness questionnaire utilized to collect the flight data. For the actual questionnaire, the student form was printed on one side of the sheet and the instructor form on the opposite side with a self-adhesive tab provided to allow the student to seal the folded questionnaire before the instructor entered his ratings.

the squadron population as a whole. This section also includes statistics describing the performance of the students on the laboratory motion reactivity tests which were administered to a large segment of the group before they began NFO training. The fourth section provides a brief comparison of the airsickness indices and laboratory test scores of the students who were graduated from the squadron with the students who attrited from the squadron prior to graduation. The fifth section utilizes the flight indices to both define and compare the performance of nonsusceptible student groups with the most susceptible student groups within the over-all population. The sixth section presents a rank correlation matrix analysis of the relationships found to exist between and across the different flight indices and laboratory test scores. The last section compares the VT86-AJN advanced squadron flight indices of airsickness with the VT10 basic squadron indices of the same students.

AIRSICKNESS INCIDENCE AND SEVERITY: INDIVIDUAL-HOP BASIS

The airsickness and related response measures derived from the questionnaires are tabulated in Table I for each of the 14 hops comprising the VT86-AJN flight syllabus. The table contains separate listings for the student and instructor ratings of the incidence and relative magnitude of the four principal response measures of the study; i.e., airsickness, vomiting, inflight performance degradation caused by airsickness, and nervousness. For each of these measures, four percentage values corresponding to classifications present, mild, moderate, severe are presented for each of the 14 hops. Each datum below a given hop name (see Appendix A for a brief description of each hop) represents the percentage of the total number of hops flown of the given type where the denoted response occurred. The first datum presented for a given response, e.g., "Airsickness-Present," is the percentage of the hops where airsickness was present without qualification as to the magnitude (mild, moderate, or severe) of the response. The three following values describe the percent incidence of mild, moderate, and severe ratings, respectively, for the denoted questionnaire item. In the case of the vomit measure, the breakdown is based upon the number of times the response occurred on a given flight. The student questionnaire tabulation also contains a line item describing the percent incidence of flights where the students reported that airsickness medication was used. In the instructor tabulation, separate listings are provided for flight turbulence and a breakdown of the grades issued on a given hop. The data presented in the "Total" column at the extreme right in the table represent the percentage of the total number of hops flown (1,833) where the denoted responses were present.

As indicated in the "Total" column of Table I, the students reported that airsickness (mild, moderate, or severe) was present on 8.6 percent of the hops flown during advanced training in this squadron; their instructors estimated the incidence to be only 4.3 percent. These figures indicate that the airsickness problem in this specific advanced training squadron was of smaller magnitude than that observed during basic training in Squadron VT10 where the students and instructors reported (3) that airsickness was present on 16.2 and 10.2 percent, respectively, of the total hops flown. In the case of the vomit measure, the VT86-AJN

Table I

Percent incidence of airsickness and related flight questionnaire responses on the fourteen hops comprising the pre-1978 flight syllabus of Advanced Training Squadron VT86-AJN. The student and instructor questionnaire data are listed separately with each datum shown below a given hop representing the percentage of the total hops flown of the given type where the denoted response occurred. The total column at the right represents the percent incidence of a given response based upon all 1,833 hops flown by the 134 NFO students comprising this specific study population.

FLIGHT QUESTIONNAIRE RESPONSES	INDIVIDUAL HOPS COMPRISING SQUADRON FLIGHT SYLLABUS														
	LL1	LL2	LL3	LL4	RN1	RN2	D1	RN3	[illegible]N1	RN4	D2	PA1	PA2	PA3	TOTAL
HOPS FLOWN-PERCENT OF TOTAL	6.9	7.9	8.1	9.5	7.1	6.6	6.1	6.9	6.4	7.8	5.6	6.7	7.4	6.9	100.
S-AIRSICKNESS-PRESENT	20.5	13.1	7.4	6.3	3.1	1.7	33.3	2.4	2.5	3.5	26.2	1.6	2.9	3.2	8.6
S-AIRSICKNESS-MILD	14.2	11.0	4.0	5.7	2.3	1.7	23.4	1.6	2.5	2.1	17.5	1.6	2.2	3.2	6.3
S-AIRSICKNESS-MODERATE	4.7	2.1	3.4	.6	.8	.0	9.0	.8	.0	1.4	8.7	.0	.0	.0	2.1
S-AIRSICKNESS-SEVERE	1.6	.0	.0	.0	.0	.0	.9	.0	.0	.0	.0	.0	.7	.0	.2
S-VOMITING-PRESENT	7.1	3.4	2.7	1.7	.0	.0	10.9	1.6	.0	1.4	16.5	1.6	.7	.0	3.7
S-VOMITING-1 TIME	5.5	2.0	1.3	1.7	.0	.0	9.9	.8	.0	1.4	10.7	.8	.7	.0	2.3
S-VOMITING-2 TIMES	1.6	.7	.7	.0	.0	.0	8.1	.0	.0	.0	3.9	.0	.0	.0	1.0
S-VOMITING-3 OR MORE TIMES	.0	.0	.7	.0	.0	.0	.9	.0	.0	.0	1.9	.0	.0	.0	.3
S-PERF. DEGRADATION-PRESENT	8.7	1.4	2.7	.6	.0	.0	15.3	2.4	.0	2.8	9.7	.0	2.9	1.6	3.4
S-PERF. DEGRADATION-MILD	7.1	.0	2.7	.6	.0	.0	12.6	2.4	.0	1.4	7.8	.0	2.9	1.6	2.7
S-PERF. DEGRADATION-MODERATE	1.6	1.4	.0	.0	.8	.0	1.8	.0	.0	1.4	1.9	.0	.0	.0	.6
-PERF. DEGRADATION-SEVERE	.0	.0	.0	.0	.0	.0	.9	.0	.0	.0	.0	.0	.0	.0	.1
S-NERVOUSNESS-PRESENT	55.1	49.7	36.9	44.0	27.5	29.8	44.1	21.3	25.4	23.8	25.2	19.5	35.3	28.2	33.8
S-NERVOUSNESS-MILD	44.9	45.5	30.9	33.7	26.0	28.1	33.3	20.5	21.2	19.6	23.3	12.2	28.7	22.6	28.3
S-NERVOUSNESS-MODERATE	10.2	4.1	5.4	9.7	1.5	1.7	9.9	.8	3.4	3.5	1.9	5.7	6.6	4.8	5.1
S-NERVOUSNESS-SEVERE	.0	.0	.7	.6	.0	.0	.9	.0	.8	.7	.0	1.6	.0	.0	.4
S-MEDICATION USED ON HOP	.0	.0	1.3	1.1	1.5	.0	5.4	.0	.8	1.4	6.8	.0	.0	.0	1.2
I-AIRSICKNESS-PRESENT	10.2	2.8	1.3	1.1	.0	1.7	20.7	.8	1.7	2.1	21.4	1.6	1.5	.0	4.3
I-AIRSICKNESS-MILD	7.1	1.4	1.3	.6	.0	.8	11.7	.0	1.7	1.4	15.5	.8	1.5	.0	2.8
I-AIRSICKNESS-MODERATE	2.4	.7	.0	.6	.0	.8	9.0	.8	.0	.7	5.8	.8	.0	.0	1.4
I-AIRSICKNESS-SEVERE	.8	.7	.0	.0	.0	.0	.0	.8	.0	.0	.0	.0	.0	.0	.1
I-VOMITING-PRESENT	5.5	2.1	1.3	1.1	.0	.0	16.2	.8	.0	1.4	14.6	1.6	.7	.0	2.9
I-VOMITING-1 TIME	3.9	1.4	.7	1.1	.0	.0	9.9	.0	.0	.0	10.7	1.6	.7	.0	2.0
I-VOMITING-2 TIMES	1.6	.7	.7	.0	.0	.0	4.5	.8	.0	.7	1.9	.0	.0	.0	.7
I-VOMITING-3 OR MORE TIMES	.0	.0	.0	.0	.0	.0	1.8	.0	.0	.7	1.9	.0	.0	.0	.3
I-PERF. DEGRADATION-PRESENT	3.9	2.1	.7	.6	.0	1.7	9.9	.8	.0	1.4	11.7	.8	1.5	.0	2.2
I-PERF. DEGRADATION-MILD	1.6	.7	.7	.6	.0	1.7	8.1	.8	.0	.0	9.7	.8	1.5	.0	1.6
I-PERF. DEGRADATION-MODERATE	2.4	1.4	.0	.0	.0	.0	1.8	.0	.0	.7	1.9	.0	.0	.0	.5
I-PERF. DEGRADATION-SEVERE	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0	.0	.1
I-NERVOUSNESS-PRESENT	36.2	33.8	26.2	26.9	21.4	18.2	11.7	13.4	23.7	18.9	9.7	19.5	27.2	21.0	22.5
I-NERVOUSNESS-MILD	29.1	25.5	20.1	18.9	19.1	14.9	9.9	10.2	20.3	17.5	8.7	13.8	22.0	17.7	18.1
I-NERVOUSNESS-MODERATE	5.5	7.6	5.4	6.9	2.[illegible]	3.3	1.8	2.4	2.5	1.4	1.0	3.3	3.7	3.2	3.8
I-NERVOUSNESS-SEVERE	1.6	.7	.7	1.1	.0	.0	.0	.0	.8	.0	.0	2.4	.7	.0	.7
I-TURBULENCE-PRESENT	48.8	40.7	38.9	36.6	19.1	19.0	18.0	22.8	18.6	21.0	18.4	44.7	35.3	12.9	28.9
I-TURBULENCE-MILD	34.6	26.9	28.9	30.3	16.0	16.5	12.6	16.5	11.9	13.3	12.6	33.3	25.7	11.3	21.3
I-TURBULENCE-MODERATE	14.2	13.8	8.1	6.3	3.1	2.5	5.4	6.3	6.8	7.7	5.8	8.9	9.6	1.6	7.3
I-TURBULENCE-SEVERE	.0	.0	2.0	.0	.0	.0	.0	.0	.0	.0	.0	2.4	.0	.0	.3
I-FLT. GRADES-ISSUED ON HOP	94.5	93.1	94.6	91.4	91.6	96.7	99.1	95.3	94.9	90.9	95.1	91.9	91.9	97.6	94.0
I-FLT. GRADES-UNSATISFACTORY	.0	.8	1.6	1.7	.2	.1	.7	.8	.9	1.7	.4	1.3	2.1	2.2	1.2
I-FLT. GRADES-BELOW AVERAGE	3.8	9.0	9.8	11.5	3.1	6.0	7.3	6.5	7.8	8.3	5.3	7.9	11.4	7.4	7.9
I-FLT. GRADES-AVERAGE	88.0	80.6	76.9	73.6	[illegible]5.1	79.2	86.5	77.[illegible]	78.1	75.7	85.6	73.9	71.1	73.8	78.1
I-FLT. GRADES-ABOVE AVERAGE	8.2	9.5	11.7	13.2	11.6	14.6	5.5	15.4	13.2	14.3	8.7	16.0	15.4	16.6	12.9

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

students and instructors reported that this response occurred on 3.7 and 2.9 percent, respectively, of the total hops flown. The over-all incidence of inflight performance degradation due to airsickness was also relatively low in the squadron, with the students and instructors reporting its presence on only 3.4 and 2.2 percent, respectively, of the total flights. Student nervousness, experienced either prior to or during a flight, was reported by the students and instructors on 33.8 and 22.5 percent, respectively, of the flights. This measure was included to explore potential relationships between it and other measures, both inflight and on the motion reactivity test battery.

To illustrate the relative magnitude of the airsickness problem among the different hops comprising the Squadron VT86-AJN flight syllabus, selected elements of Table I have been plotted in Figures 3 through 9. In these figures, each hop is identified with an abbreviated code that is explained in Appendix A. All of the hops were flown in the multi-seated T39-D aircraft with the exceptions of D1 and D2 which were flown in the two-seated TA-4J aircraft. The hop name-labeling sequence in these figures reading from left to right follows, in general, the sequence that the students flew the hops, although there were variations from student to student. This sequence was determined by numbering each hop flown by a given student in the order that it was flown and calculating the mean ordinal number for the named hop for the entire student group. Since questionnaires were not necessarily received from every student for every flight comprising the syllabus, this mean sequence only approximates the actual order of the different hops. From a practical viewpoint, this method well approximates the over-all hop sequence flown by the majority of the students, with the chance of sequence error greatest between two adjacent hop listings for any given student.

The distribution of the basic flight data available for analysis on an individual-hop basis is depicted in Figure 3 where the number of questionnaires collected for a given hop is expressed as the percentage of the total number (1,833) of questionnaires received. Variations in the exact number of questionnaires received per hop are due to less than 100 percent return, which was sometimes compensated by repeat hops flown by the students. Of the 1,833 questionnaires received, 294 (about 16 percent) involved students repeating a hop they had previously flown.

In Figure 4 the student and instructor ratings of airsickness are compared for each hop. Figure 4A plots the incidence of airsickness, regardless of degree of severity, that occurred on a given hop as the percentage of the total hops flown where airsickness was present. Figures 4B, 4C, and 4D depict the percent incidence of hops where airsickness was present to a mild, moderate, and severe degree, respectively. Figures 5, 6, and 7 represent equivalent plots of the incidence of vomiting, inflight performance degradation due to airsickness, and nervousness, respectively, questionnaire items. In general, both the incidence and severity of airsickness were greatest on Hop D1, the indoctrination flight in the TA-4J aircraft. Of the total number of D1 flights, the students reported that 33.3 percent of the hops produced airsickness (Figure 4A), 18.9 percent resulted in vomiting one or more times (Figure 5A), and 15.3 percent caused performance degradation due

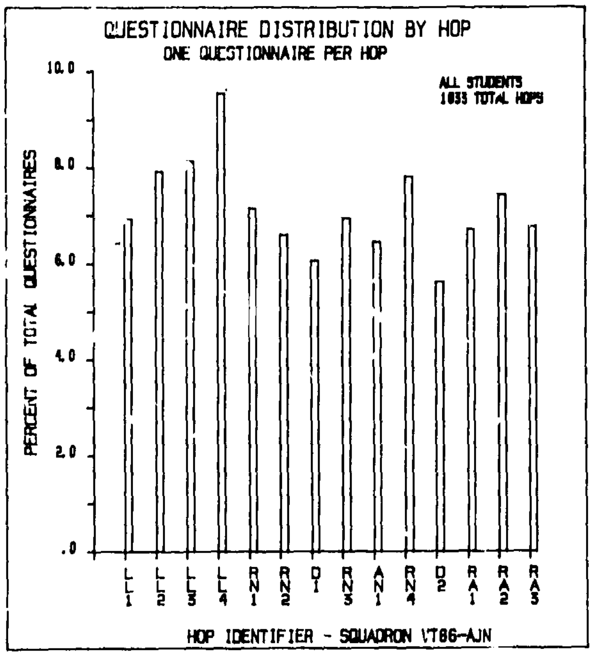

Figure 3

Plot of relative distribution of airsickness questionnaires received during the study as a function of the individual hops comprising the squadron flight syllabus. Each bar above a given hop corresponds to the percentage of the total number of questionnaires collected during the study that pertained to the specific hop. The left-to-right hop sequence shown corresponds in general to the sequence that the students flew the hops, although there were exceptions within each hop series.

to airsickness (Figure 6A). These incidence figures were closely followed by Hop D2 (demonstration of mild acrobatic maneuvers in the TA-4J) and then Hop LL1 (the first hop of the squadron syllabus flown in the T-39D). As indicated by Figure 7, the incidence of nervousness was greatest at the beginning of the flight syllabus and then reflected a downward trend as training progressed.

Figure 8 is a plot of the percent incidence of airsickness medication usage as reported by the students. These data indicate a relatively low use of such medication during training, with the exceptions of the D1 and D2 hops. This reported usage of medication during the mid-to-late phases of the training program, and on the two most stressful hops of the syllabus, requires further investigation since this practice tends to allow airsick susceptibles to continue in the program without the natural screening that might occur without medication. This same trend was observed during basic training in Squadron VT10 (3).

The turbulence or roughness-of-air data provided by the instructors following each flight are plotted in Figure 9. These data indicate that turbulence was considered to be greatest on the four hops comprising the LL series and two of the hops comprising the RA series. As indicated in Appendix A, these hops usually involved some form of low-level flight

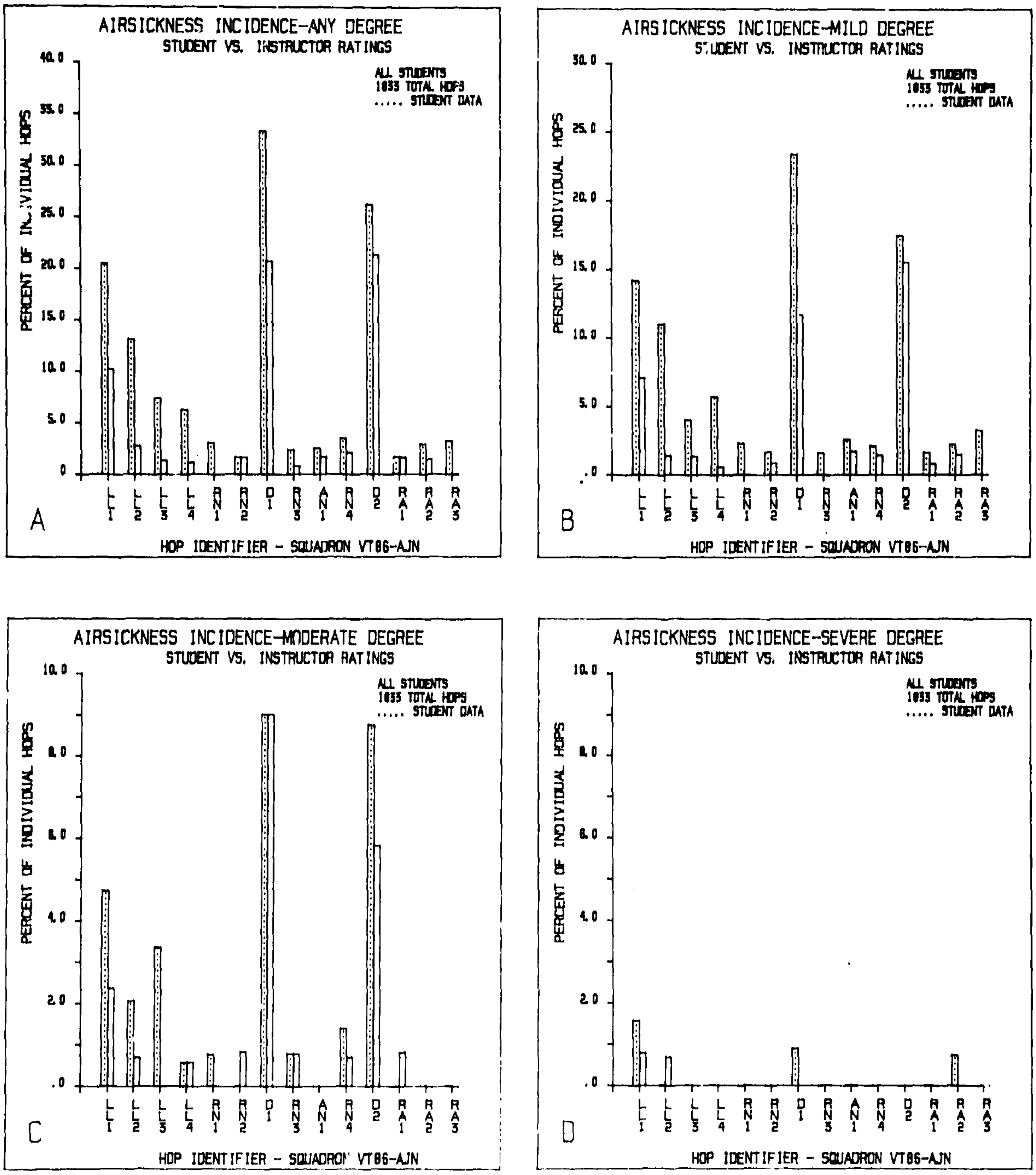

Figure 4

Comparison of student and instructor ratings of airsickness incidence and severity as a function of the individual hops. The incidence of airsickness of any degree (mild, moderate, or severe) is shown in A; the incidence of mild, moderate, and severe degrees of airsickness in B, C, and D, respectively. In each case, incidence is expressed as the percentage of the total number of hops flown of a given classification where the denoted response occurred. In general, the instructor judgments of airsickness incidence and severity underestimate those provided by the students. Hops D1 and D2, flown in the TA-4J aircraft, produced the greatest airsickness stress.

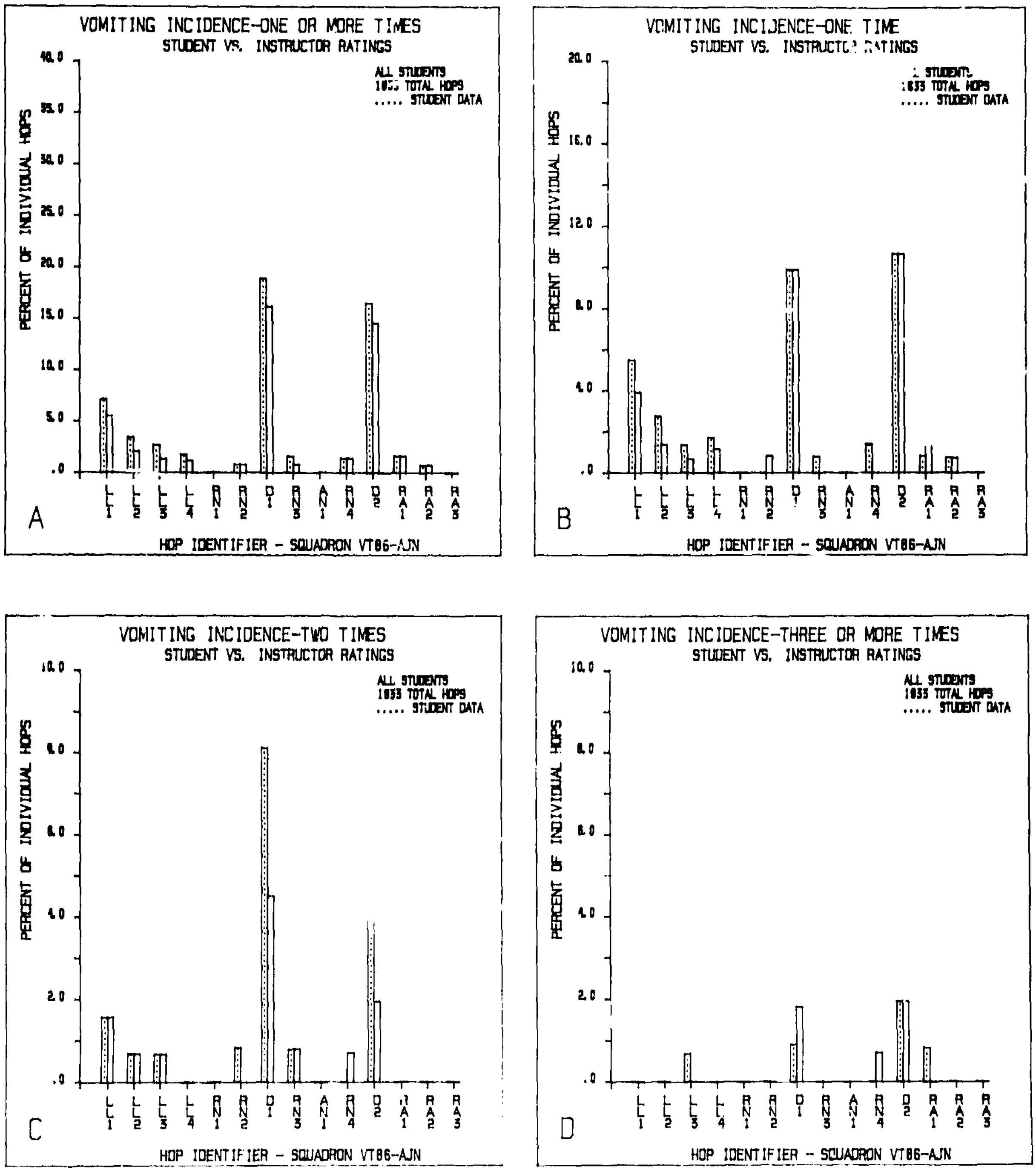

Figure 5

Comparison of student and instructor ratings of vomiting incidence as a function of the individual hops. The percent incidence of hops resulting in students vomiting one or more times is shown in A; the incidence of hops where the students vomited one, two, or three times is shown in B, C, and D, respectively.

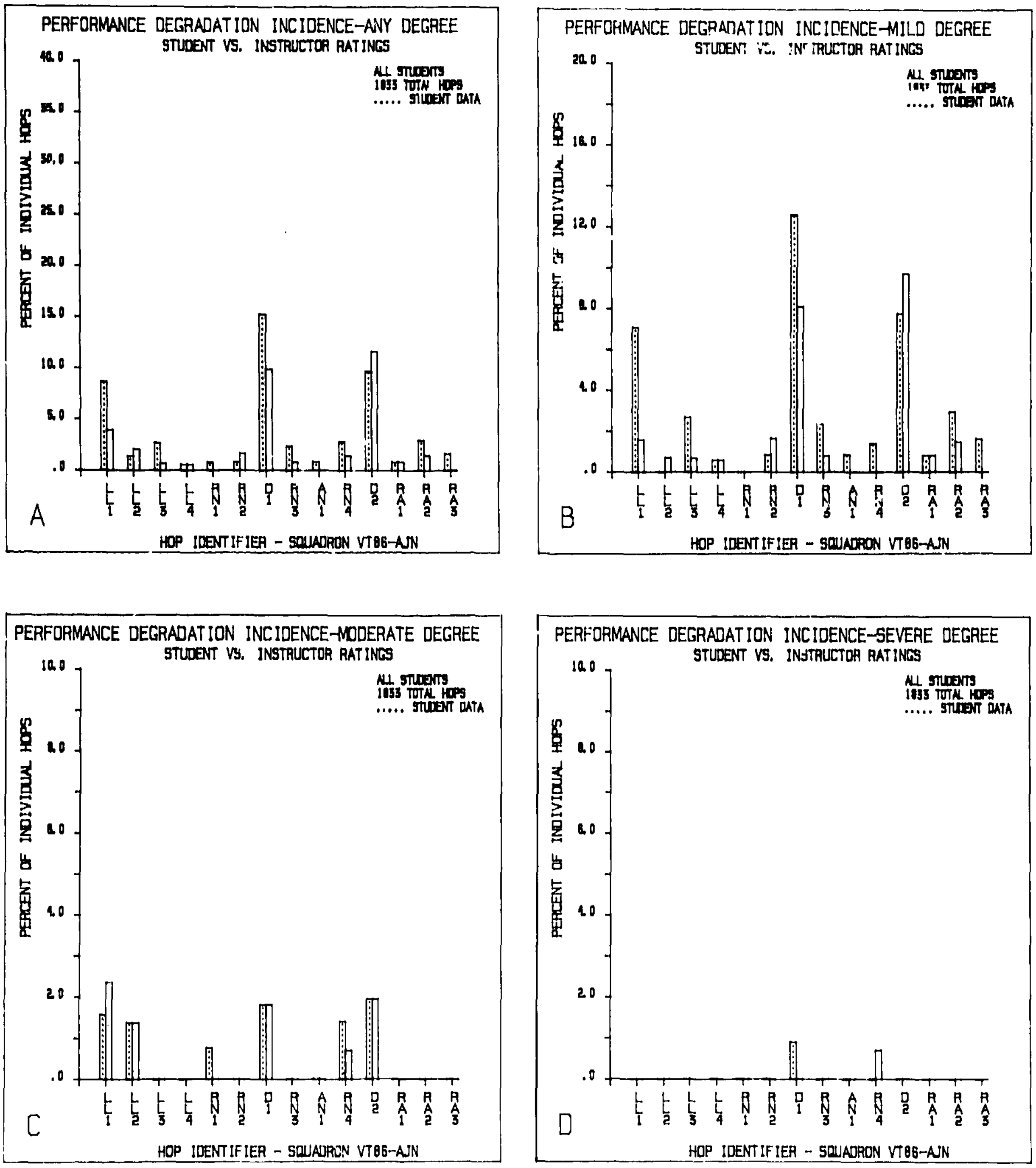

Figure 6

Comparison of student and instructor ratings of inflight performance degradation caused by airsickness as a function of the individual hops. On most hops, the students overestimated the extent of their performance degradation as compared to the instructor judgments.

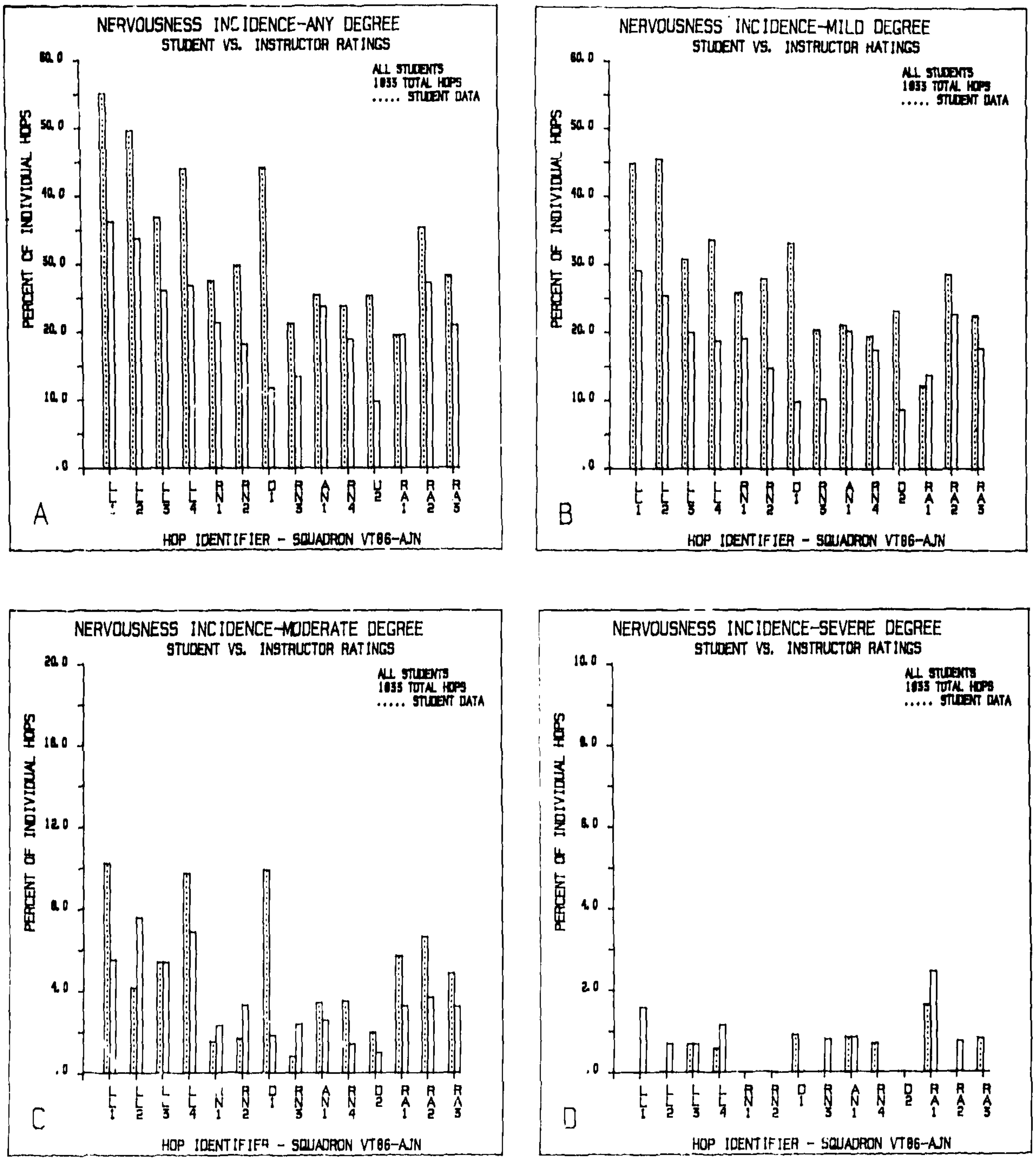

Figure 7

Comparison of student and instructor judgments of student nervousness before or during a given flight as a function of the individual hops.

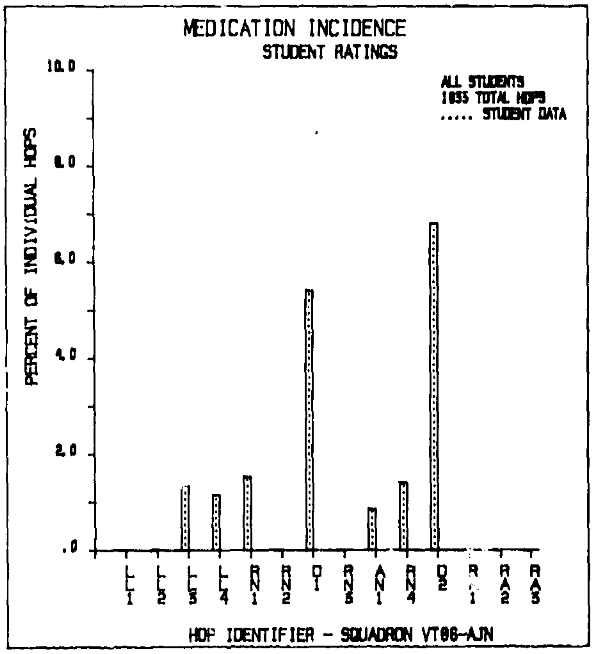

Figure 8

Percent incidence of flights where students reported using airsickness medication. The use of medication was greatest on hops D1 and D2 which occurred in the mid-to-late phases of the flight syllabus.

where turbulence or buffeting might be expected. As mentioned in the first report of the series (3), concern was expressed that because of the inclusion of the words, "pilot technique," in the roughness-of-air item included in the questionnaire (Figure 2 - bottom) certain VT10 instructors may have based their judgments upon the over-all magnitude of the flight forces associated with a given hop rather than simple atmospheric turbulence. That is, it appeared that the VT10 flights involving stress-level maneuvers were ranked high in turbulence level. This does not appear to be the case for the VT86-AJN data, in that the D2 hop involving acrobatics was not highly related relative to roughness-of-air. The distribution of the Figure 9 turbulence data, when related to the data of Figures 4, 5, and 6, does not indicate any strong relationship between the incidence of turbulence and the incidence of airsickness. There was a trend, however, for airsickness to follow turbulence level for the first four hops (LL1-LL4) of the syllabus which involved low-level flight.

The flight grade data listed in Table I are plotted as a function of the individual hops in Figure 10. The squadron grading protocol was such that an instructor issued one of four grades (average, above average, below average, or unsatisfactory) for each of the flight performance

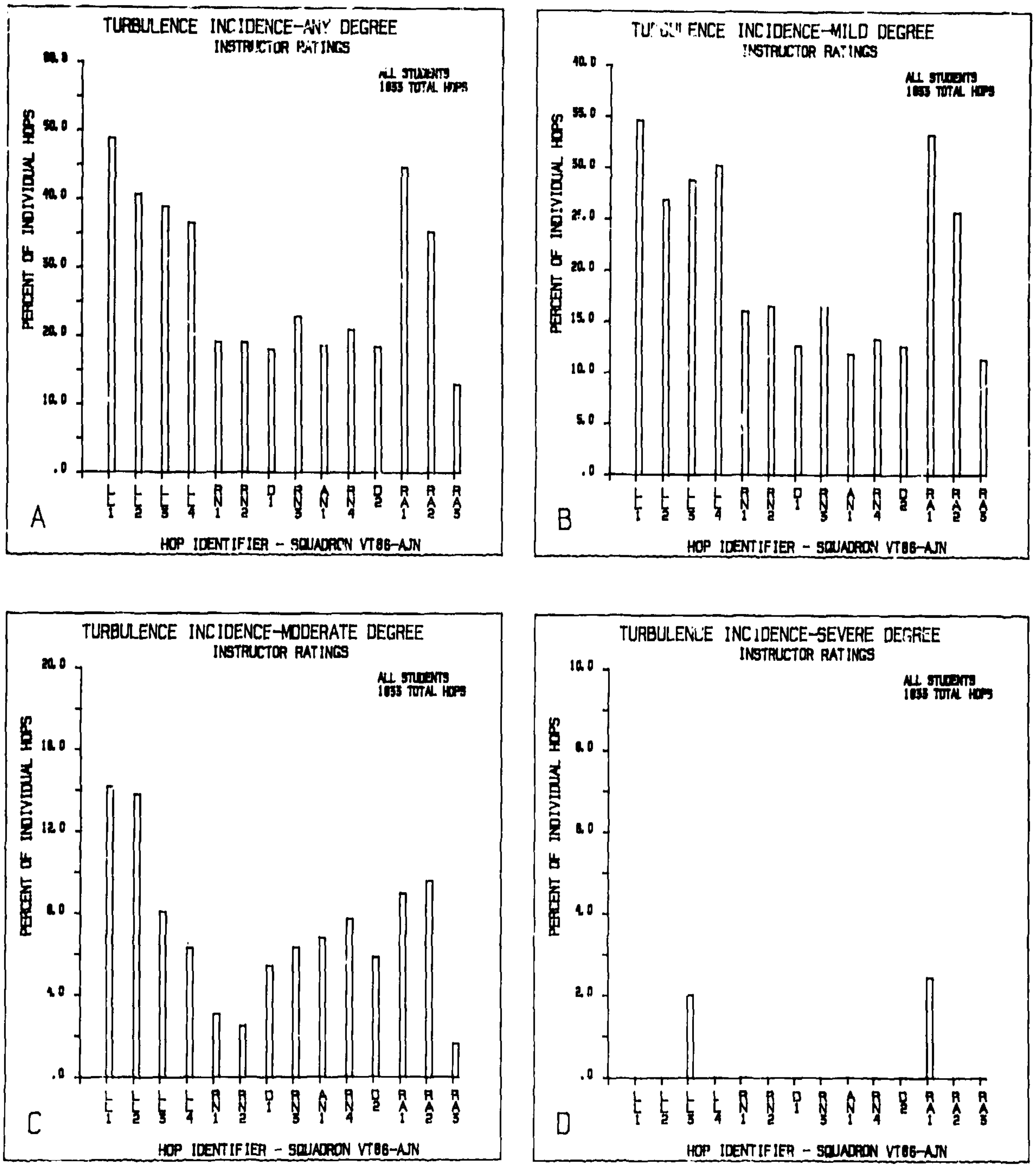

Figure 9

Percent incidence of turbulence (rough air or pilot technique) as a function of the individual hops.

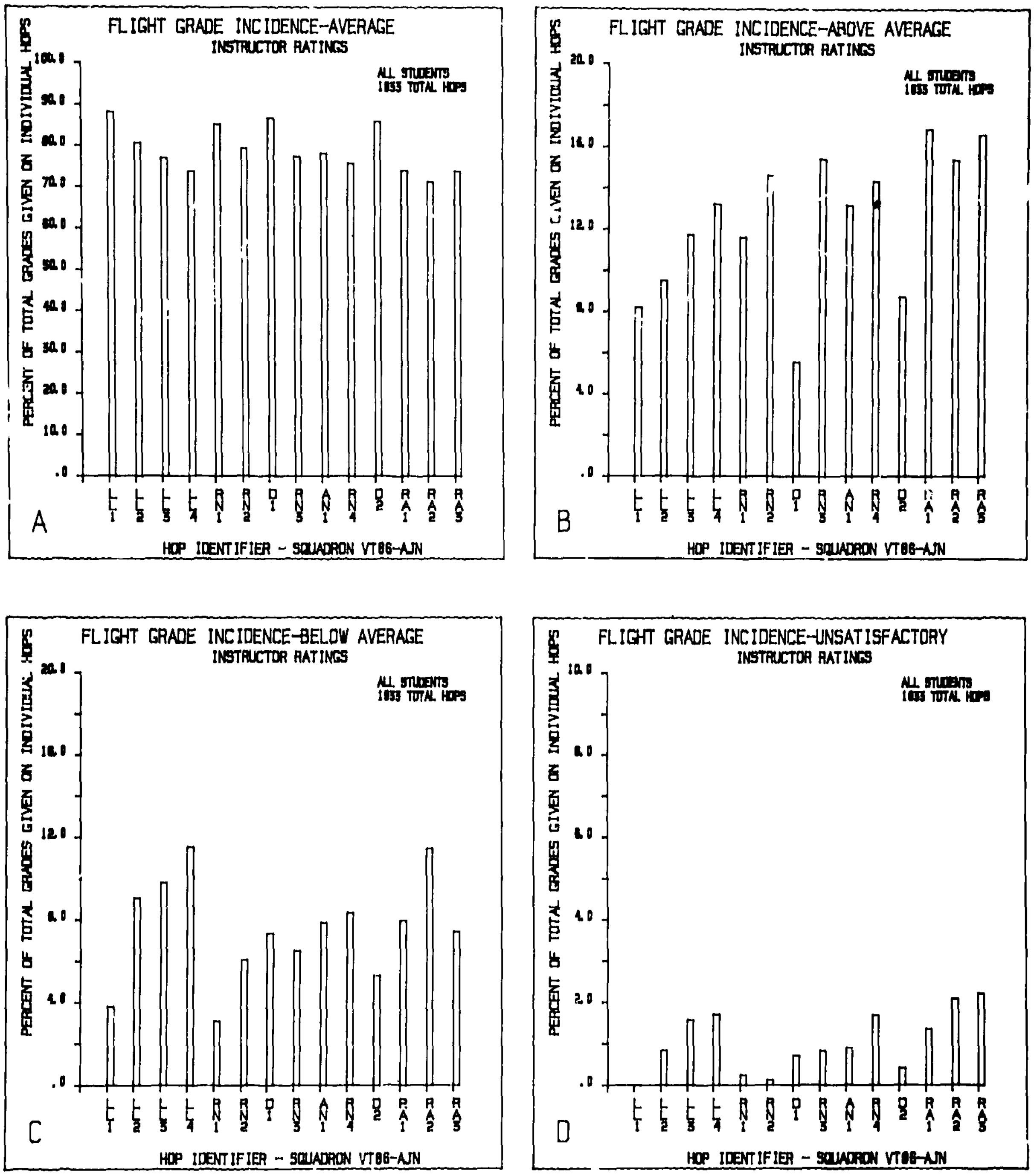

Figure 10

Percent incidence of average (A), above average (B), below average (C), and unsatisfactory (D) grades for the individual hops. The grading system is based upon assigning one of these four grades to each task performed on a given hop where the number of tasks graded varies from hop to hop. Each datum plotted in this figure represents the percentage of the total number of grades given on a specific hop where the denoted grade was issued.

tasks to be practiced on a given hop. The percentage data plotted in Figure 10 are referenced to the total number of grades issued on a given hop. The "average" grade data of Figure 10 indicate a relatively even distribution across the individual hops. The most noticeable distribution difference seems to be in the relatively low incidence of "above average" grades (Figure 10B) given on the D1 and D2 hops that were flown in the TA-4J aircraft. As indicated by Figure 10C, however, the incidence of "below average" grades on these two hops was not distinctly different from the other hops.

In the previous report (3) dealing with airsickness incidence in Basic Training Squadron VT10, it was found that the last three hops (FO series) flown in the syllabus produced relatively high airsickness incidence. This finding was used to emphasize the point that adaptation effects cannot be deduced from a simple analysis of airsickness as a function of the number of hops flown within a given squadron. That is, airsickness incidence, at least for the NFO population, did not continuously decrease as the students progressed through the flight syllabus. When the VT10 hops involved relatively high stress levels, airsickness incidence rose even though the hops occurred toward the end of the flight syllabus. The same trend may be observed for these VT86-AJN data in that airsickness incidence was greatest on the D1 and D2 hops, which occurred near the middle and end, respectively, of the syllabus. Our results suggest that conclusions concerning airsickness adaptation must be carefully weighed in relation to the stress level of each hop within a given flight syllabus.

AIRSICKNESS INCIDENCE AND SEVERITY: STUDENT FREQUENCY ANALYSIS

The flight data were also analyzed to establish the number of students who experienced a given response a repeated number of times during the course of their training. Table II is a tabulation of the results of this analysis for each of the principal questionnaire responses. Each datum in this table below a given column heading denotes the percentage of the total number of students who experienced a given response the number of times indicated by the column header. The total column at the extreme right in the table denotes the percentage of the total number of students who experienced the given response one or more times.

These total data indicate that 55.2 percent of the students reported being airsick on one or more flights during their VT86-AJN training, 28.4 percent reported vomiting on one or more flights, 30.6 percent reported inflight performance degradation due to airsickness on one or more flights, and 80.6 reported nervousness on one or more flights. As indicated by the 0.7 percent datum under the "10" column heading of Table II, one student reported being airsick on ten of his hops. Table II, like Table I, reflects the lower magnitude of the instructor ratings as compared to those of the students.

To emphasize the large contribution of a small number of students to the over-all airsickness problem, the airsickness, vomiting, performance degradation, and nervousness data have been plotted in cumulative frequency distribution form in Figures 11A, B, C, and D, respectively. The percentage of the total number of students who never

Table II

Relative incidence of students experiencing repeated airsickness a different number of times during flight training in Squadron VT86-AJN. Each datum listed beneath a given column number represents the percentage of the total student population (N = 134) that experienced a given response the denoted number of times. The total column at the right represents the percentage of the total population that experienced a given response one or more times during flight training.

FLIGHT QUESTIONNAIRE RESPONSES	NUMBER OF TIMES RESPONSE EXPERIENCED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
S-AIRSICKNESS-PRESENT	26.9	14.2	5.2	4.5	1.5	1.5	.7	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	55.2
S-AIRSICKNESS-MILD	27.6	10.4	5.2	2.2	.7	.7	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	47.8
S-AIRSICKNESS-MODERATE	14.2	5.2	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	20.1
S-AIRSICKNESS-SEVERE	1.5	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.2
S-VOMITING-PRESENT	15.7	8.2	1.5	2.2	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	28.4
S-VOMITING-1 TIME	14.2	3.0	3.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	20.9
S-VOMITING-2 TIMES	11.2	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	12.7
S-VOMITING-3 OR MORE TIMES	2.2	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.0
S-PERF. DEGRADATION-PRESENT	22.4	5.2	1.5	.0	.7	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	30.6
S-PERF. DEGRADATION-MILD	16.4	5.2	.7	.0	.7	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	23.9
S-PERF. DEGRADATION-MODERATE	8.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	8.2
S-PERF. DEGRADATION-SEVERE	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7
S-NERVOUSNESS-PRESENT	11.9	9.0	8.2	11.2	6.7	7.5	6.7	3.0	1.5	3.0	2.2	.7	2.2	2.2	1.5	1.5	.0	1.5	80.6
S-NERVOUSNESS-MILD	10.4	11.2	10.4	9.7	10.4	6.7	2.2	3.0	1.5	2.2	3.0	1.5	2.2	.0	1.5	.0	.0	.7	76.9
S-NERVOUSNESS-MODERATE	23.9	6.7	2.2	.7	.7	.7	.0	.0	.7	.7	.0	.0	.0	.0	.0	.0	.0	.0	36.6
S-NERVOUSNESS-SEVERE	3.0	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.5
S-MEDICATION USED ON HOP	1.5	2.2	2.2	.0	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.7
I-AIRSICKNESS-PRESENT	26.1	6.0	2.2	1.5	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	37.3
I-AIRSICKNESS-MILD	16.4	3.7	3.7	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	24.6
I-AIRSICKNESS-MODERATE	15.7	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	17.2
I-AIRSICKNESS-SEVERE	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.5
I-VOMITING-PRESENT	15.7	6.0	.0	2.2	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	24.6
I-VOMITING-1 TIME	11.2	3.7	.7	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	17.2
I-VOMITING-2 TIMES	9.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	9.7
I-VOMITING-3 OR MORE TIMES	3.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.7
I-PERF. DEGRADATION-PRESENT	16.4	3.0	.7	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	21.6
I-PERF. DEGRADATION-MILD	12.7	2.2	.7	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	16.4
I-PERF. DEGRADATION-MODERATE	7.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	7.5
I-PERF. DEGRADATION-SEVERE	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7
I-NERVOUSNESS-PRESENT	18.7	11.2	18.7	16.4	11.2	3.7	3.7	.7	3.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	88.1
I-NERVOUSNESS-MILD	20.1	19.4	17.2	11.9	10.4	4.5	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	85.1
I-NERVOUSNESS-MODERATE	21.6	9.7	1.5	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	34.3
I-NERVOUSNESS-SEVERE	3.7	1.5	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.0
I-TURBULENCE-PRESENT	9.7	17.9	11.9	17.9	10.4	8.2	9.7	3.7	2.2	1.5	.7	.0	.0	.0	.0	.0	.0	.0	94.0
I-TURBULENCE-MILD	16.4	17.9	23.1	11.2	9.7	5.2	3.0	2.2	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	89.6
I-TURBULENCE-MODERATE	33.6	20.9	6.0	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	61.9
I-TURBULENCE-SEVERE	4.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.5

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

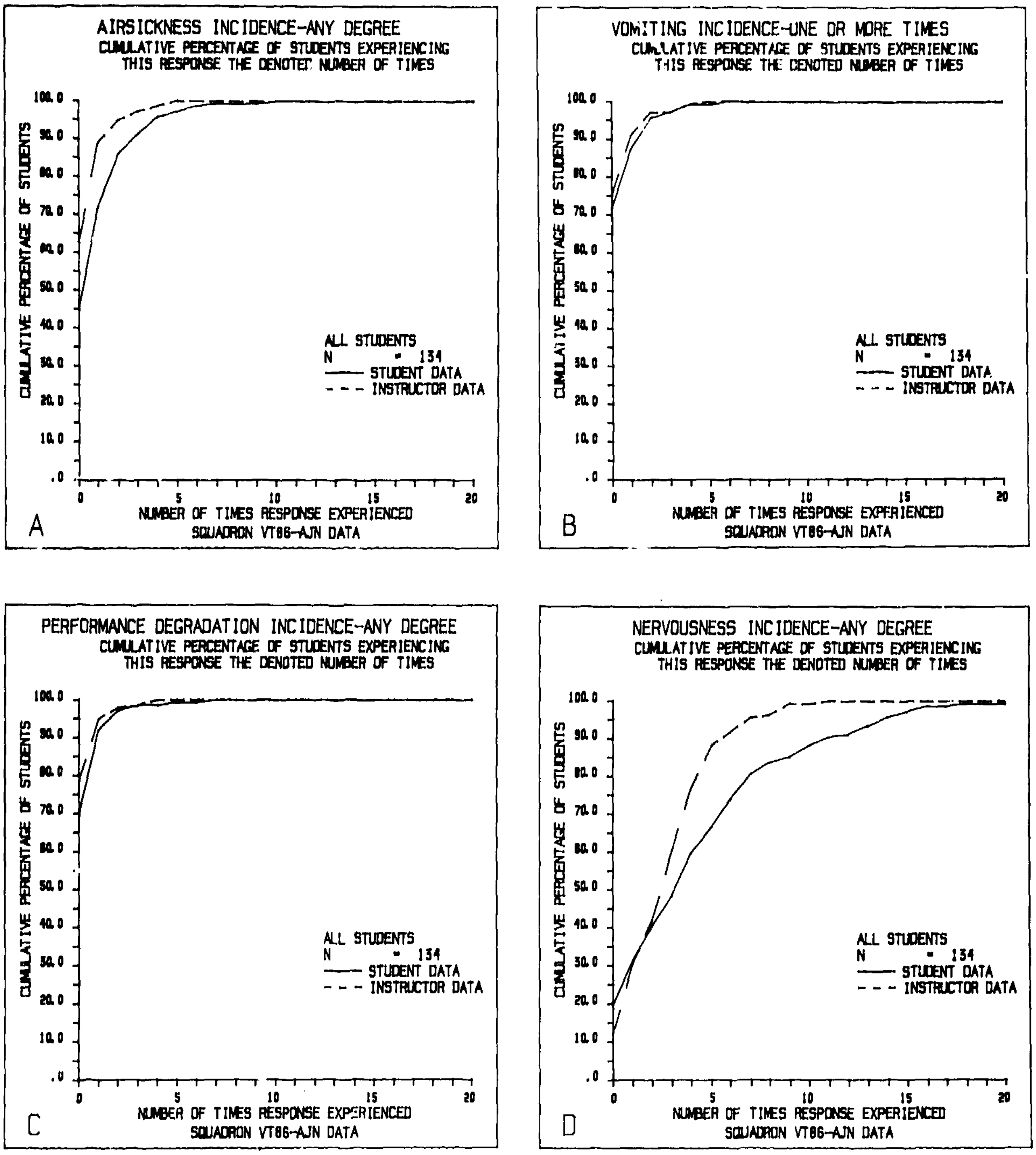

Figure 11

Normalized cumulative frequency distribution of students experiencing airsickness (A), vomiting (B), inflight performance degradation (C), and nervousness (D) a different number of times during the course of their flight training in this squadron based upon both student (solid line) and instructor (dashed line) data.

reported experiencing a given response is represented in these figures by the intersection of the distribution curve with the ordinate axis. In summary, 44.8 percent of the students reported never being airsick, 71.6 percent reported never vomiting, 69.4 percent reported never suffering from inflight performance degradation due to airsickness, and 19.4 percent reported never experiencing nervousness prior to or during flight. As represented by the steep slopes of the Figures 11A, B, and C distribution curves, only a relatively small number of students experienced airsickness, vomiting, or performance degradation on more than two flights in this squadron. For example, when one relates the student airsickness data of Table II to the total number of flights where airsickness occurred (Table I), it may be shown that only 18 (13.4 percent of the total) students were airsick on more than two hops, and they accounted for 53 percent of the total number of hops where airsickness was reported to be present. In like manner, it can be shown that 50 percent of the hops where airsickness occurred was accounted for by slightly less than 13 percent of the total number of students; 50 percent of the hops where vomiting and inflight performance degradation occurred was accounted for by approximately 8 percent of the students, and 50 percent of the hops where nervousness occurred was accounted for by only 18 percent of the students. As mentioned previously (3) the long-term objective in the development of tests to predict airsickness susceptibility must center on the identification of those individuals falling into the upper part, e.g., the upper decile, of the Figure 11 distributions.

Normalized cumulative frequency distributions of the same form are also plotted for student reports of medication usage in Figure 12A and for instructor ratings of turbulence in Figure 12B. The significance of the medication plot is that only nine (6.7 percent) of the squadron students reported using medication at any time during training. Of these students, two used medication on one flight, three on two flights, three on three flights, and one on five flights. As with the Squadron VT10 data (3), the incidence of medication usage shown in Table I and plotted in Figure 8 was accounted for by only a few students. The turbulence data of Figure 12B show that the repeated exposure to roughness of air was more evenly distributed over the population.

INDIVIDUAL STUDENT PERFORMANCE: AIRSICKNESS INDICES

Unweighted and weighted indices were calculated for the principal components of the airsickness questionnaire data, using both the student and instructor ratings. The indices allow comparisons to be made among different squadrons and among different student subpopulations within given squadrons. In addition, they are intended to serve the further function of relating an individual's performance during basic training with subsequent performance in advanced and fleet readiness (RAG) squadrons. As outlined in the first report (3), five unweighted and five weighted indices were calculated for each student, using the airsickness, vomiting, performance degradation, nervousness, and medication usage components of the <u>student</u> questionnaire as measurement references. Similarly, for the <u>instructor</u> data pertaining to the same student, five unweighted and

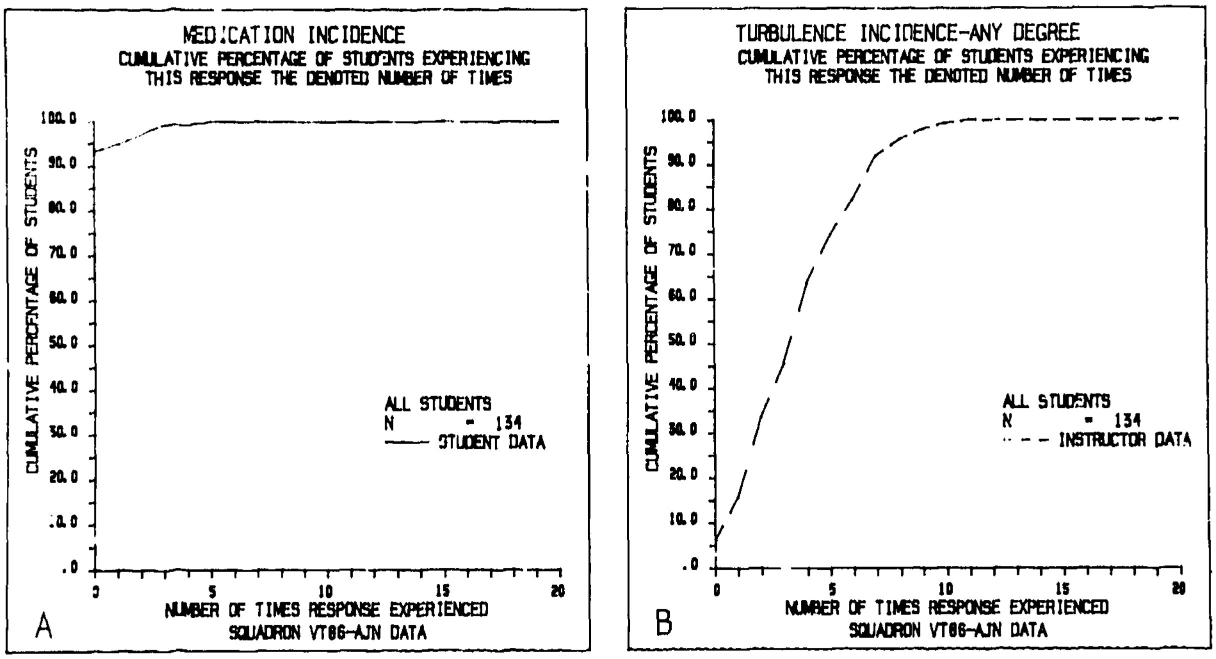

Figure 12

Normalized cumulative frequency distribution of students utilizing medication on a repeated basis (A) and students experiencing turbulence or roughness of air on one or more flights (B). Note that the incidence of medication usage shown in Figure 8 was accounted for by a very small percentage of the total student population, as indicated in A.

five weighted indices were calculated, using the same measurement references, with the one exception of substituting the instructor rating of turbulence for the student report of medication usage. Flight indices were not calculated for those students who submitted less than four questionnaires during the study period.

The methods used to calculate the indices were keyed to structuring a computer data storage file for each student that contained a sequential tabulation of all questionnaires collected from the student during the course of his squadron training. The unweighted indices were calculated from this file as

$$1)\quad \text{RESPONSE INDEX (UNWEIGHTED)} = \frac{\text{No. Flights Response Experienced}}{\text{Total No. Flights Flown}} \times 100$$

where no weight was given to the severity of the response; i.e., attention was given only to the fact that a response such as airsickness occurred on a flight without regard to its mild, moderate, or severe degree of magnitude. Accordingly, the unweighted indices simply represent the percentage of the flights flown by the student where the denoted response such as airsickness occurred. This method of calculation of the unweighted indices was applied to each of the five student questionnaire responses and to each

of the five instructor responses, as listed above.

The weighted indices calculated for the same ten questionnaire responses were based upon the assignment of a linear weight of 0, 1, 2, 3 to the four magnitude ratings associated with all but the medication usage item. For example, if a student reported that he was not airsick on a hop, he would have a response rating of 0.0 for this particular flight; a student who reported either mild, moderate, or severe airsickness was given a response rating of 1, 2, or 3, respectively, for a particular hop. These response ratings were summed for all of the hops flown by a given student and used to calculate a weighted index that was normalized to have a maximum value of 100 as follows:

$$2)\quad \text{RESPONSE INDEX (WEIGHTED)} = \frac{\text{Sum (Individual Flight Response Ratings)}}{\text{Total No. Flights Flown}} \times \frac{100}{3}$$

To illustrate, a student who was never airsick during training would have a weighted airsickness response index of 0.0; a student who was severely airsick on all of his flights would have a corresponding weighted index of 100.0; a student who was mildly airsick on 50 percent of his flights would have an index of 16.7; and a student who was severely airsick on 50 percent of his flights would have an index of 50.0. In the case of the medication usage question, a response rating of 0 was assigned to the item if medication was not used on the flight, and 1 if used. The weighted index was also normalized to have a maximum value of 100.0, thus resulting in the unweighted and weighted indices for this one item being identical.

The resulting group statistics for the response indices of the VT86-AJN students are presented in Table III. Statistical parameters listed for each response variable include the group mean, standard deviation of the observations, standard error of the mean, minimum and maximum values observed, group median, the total number of observations (students) in the data base, and the Kolmogorov-Smirnov deviation statistic. Response variables 1 through 10 in this table represent the response indices derived from the student-based questionnaire data; variables 11 through 20 correspond equivalently to the indices derived from the instructor-based questionnaire data; variables 21 and 22 are the final academic and flight grades, respectively, received by the students upon graduating from basic training in Squadron VT10; and variables 42 and 43 are the final academic and flight grades received by those students who successfully completed advanced training in VT86-AJN.

Variables 23 through 41 in Table III describe the performance of the student group on assorted elements of the motion reactivity test battery given to many of the students prior to their beginning flight training in Squadron VT10. In brief, TMSQ1, TMSQ2, and TMSQ3 (variables 23, 24, and 25, respectively) pertain to a motion sickness history where TMSQ1 and TMSQ2 involve motion sickness experiences prior to and following age 12, with TMSQ3 equal to the sum of the TMSQ1 and TMSQ2 scores; TSANX and TTANX (variables 26 and 27) to a state/trait anxiety test; TBVDT, TBVDR, TBVDS, and TBVDP (variables 28 through 31) to a Brief Vestibular Disorientation Test (BVDT); TVVSP1, TVVSP2, and TVVSP3 (variables 32 through 34) to the static performance element of a Visual/Vestibular Interaction Test (VVIT); TVVDP1, TVVDP2, and TVVDP3 (variables 35 through

Table III

Statistical listing of the flight response indices and laboratory test scores for the Squadron VT86-AJN study population. Data presented for each response variable include the mean, standard deviation, standard error of the mean, minimum, maximum, median, and total number of students. In addition, the deviation-statistic associated with the nonparametric Kolmogorov-Smirnov one-sample test of goodness of fit of the distribution of the observed data to the distribution of an equivalent theoretical Gaussian population is listed at the right.

NO	RESPONSE VARIABLE DESCRIPTION	MEAN	S.DEV.	S.ERR.	MIN	MAX	MEDIAN	N	DEV
1	S-AIRSICKNESS INDEX-UW	9.4	14.7	1.3	.0	100.0	5.6	129	.20#
2	S-VOMITING INDEX-UW	4.0	7.7	.7	.0	44.4	.0	129	.40#
3	S-P.DEGRADATION INDEX-UW	3.6	8.3	.7	.0	75.0	.0	129	.38#
4	S-NERVOUSNESS INDEX-UW	34.5	30.9	2.7	.0	100.0	26.7	129	.16#
5	S-MEDICATION INDEX-UW	1.1	4.2	.4	.0	25.0	.0	129	.56#
6	S-AIRSICKNESS INDEX-W	4.0	6.6	.6	.0	50.0	2.0	129	.22#
7	S-VOMITING INDEX-W	1.8	3.6	.3	.0	19.3	.0	129	.40#
8	S-P.DEGRADATION INDEX-W	1.5	3.6	.3	.0	33.3	.0	129	.32#
9	S-NERVOUSNESS INDEX-W	13.5	12.9	1.1	.0	56.4	9.5	129	.15#
10	S-MEDICATION INDEX-W	1.1	4.2	.4	.0	25.0	.0	129	.56#
11	I-AIRSICKNESS INDEX-UW	5.0	8.8	.8	.0	50.0	.0	128	.31#
12	I-VOMITING INDEX-UW	3.5	7.0	.6	.0	28.6	.0	128	.43#
13	I-P.DEGRADATION INDEX-UW	2.6	6.5	.6	.0	50.0	.0	128	.40#
14	I-NERVOUSNESS INDEX-UW	24.7	17.3	1.5	.0	100.0	22.0	128	.08
15	I-TURBULENCE INDEX-UW	30.7	16.8	1.5	.0	80.0	28.6	128	.10
16	I-AIRSICKNESS INDEX-W	2.3	4.5	.4	.0	33.3	.0	128	.31#
17	I-VOMITING INDEX-W	1.6	3.3	.3	.0	16.7	.0	128	.43#
18	I-P.DEGRADATION INDEX-W	1.1	3.0	.3	.0	25.0	.0	128	.40#
19	I-NERVOUSNESS INDEX-W	10.0	8.1	.7	.0	41.7	8.6	128	.16#
20	I-TURBULENCE INDEX-W	13.0	7.7	.7	.0	40.0	12.5	128	.09
21	ACADEMIC GRADES-BASIC	51.0	4.6	.4	38.4	61.2	50.8	134	.09
22	FLIGHT GRADES-BASIC	3.0	.0	.0	3.0	3.1	3.9	134	.17#
23	TMSQ1-MS HISTORY:PART 1	8.6	11.1	1.0	.0	51.0	5.6	122	.21#
24	TMSQ2-MS HISTORY:PART 2	6.5	9.6	.9	.0	64.3	3.3	122	.22#
25	TMSQ3-MS HISTORY:SUM	15.1	18.2	1.6	.0	90.0	9.7	122	.16#
26	TSANX-STATE/ANX.QUEST.	33.2	11.3	2.7	20.0	58.0	32.0	18	.17
27	TTANX-TRAIT/ANX.QUEST.	28.1	5.4	1.3	20.0	44.0	28.0	18	.20
28	TBVDT-BVDT TIME OF DAY	9.9	1.8	.2	7.7	15.4	9.5	120	.14@
29	TBVDR-BVDT RATER	13.8	6.4	.6	6.0	47.3	11.7	123	.19#
30	TBVDS-BVDT SELF-RATING	15.0	6.9	.6	5.0	31.0	14.0	123	.14@
31	TBVDP-BVDT POST-RATING	6.0	13.6	1.3	.0	78.0	.0	118	.35#
32	TVVSP1-VVIT STATIC-RIGHT	121.0	7.2	1.4	104.0	129.0	123.0	25	.13
33	TVVSP2-VVIT STATIC-WRONG	6.0	6.0	1.2	.0	22.0	3.9	25	.21
34	TVVSP3-VVIT STATIC-OMIT	2.0	2.6	.5	.0	6.0	.0	25	.36#
35	TVVDP1-VVIT DYNAMIC-RIGHT	65.6	29.7	5.9	16.0	115.0	59.0	25	.12
36	TVVDP2-VVIT DYNAMIC-WRONG	10.8	5.8	1.2	1.0	25.0	11.0	25	.09
37	TVVDP3-VVIT DYNAMIC-OMIT	52.6	30.6	6.1	4.0	112.0	51.0	25	.09
38	TVVIR-VVIT RATER	16.3	7.5	1.5	7.5	39.0	13.5	25	.21
39	TVVIS-VVIT SELF-RATING	17.6	7.6	1.5	7.0	31.0	15.0	25	.17
40	TVVIP-VVIT POST-RATING	8.3	11.6	2.3	.0	40.0	2.0	25	.27@
41	TVVIT-VVIT TIME OF DAY	10.7	2.2	.4	8.3	13.7	9.9	25	.17
42	ACADEMIC GRADES-ADVANCED	87.7	6.1	.6	72.5	97.5	87.5	109	.08
43	FLIGHT GRADES-ADVANCED	3.1	.1	.0	2.9	3.8	3.1	109	.15#

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .1 LEVEL
# = SIGNIFICANT BEYOND THE .01 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

37) to the dynamic performance element of the VVIT; and TVVIR, TVVIS, TVVIP, and TVVIT (variables 38 through 41) to the motion sickness rating element of the VVIT.

In the interpretation of the numerical magnitude of the mean data presented in Table III, it should be realized that for the 20 flight indices, high scores denote poor performance and low scores good performance (or in the case of the turbulence measure, high scores represent greater stress than low scores). Correspondingly, for the majority of the motion reactivity test battery scores, high scores denote either poor performance or greater susceptibility to motion stress. In the case of two test scores (TVVSP1 and TVVDP1), the converse is true in that these two variables pertain to the number of correct responses produced by the students while performing the related test tasks. In the case of the TBVDT and TVVIT variables, no magnitude relationship exists relative to performance in that these measures describe the time of day (24-hour clock) that the BVD and VVI Tests were given to the student group. The converse relationship also applies to the grade data (variables 21, 22, 42, and 43) where higher scores obviously denote better student performance.

As with the Squadron VT10 data (3), the distributions of the 20 Squadron VT86-AJN flight indices are generally skewed toward the lower values of the response scale, with the median values of Table III consistently falling below the related means. Similarly, the results of a Kolmogorov-Smirnov one-sample test of goodness of fit (2) of the normalized cumulative distribution of the observed data to an equivalent Gaussian distribution with the same mean and standard deviation as the observed data indicate non-normality for the majority of the data. As indicated by the significance symbols adjacent to the Kolmogorov-Smirnov deviation statistic labeled as DEV in Table III, the null hypothesis that the distribution of the observed data is the same as a Gaussian distribution must be rejected at the .01 significance level or greater for 17 of the 20 flight indices. Plots of the normalized cumulative frequency distributions of the unweighted and weighted flight indices, along with their equivalent theoretical Gaussian distributions, are presented in Figures C1 through C5 of Appendix C for both the student- and instructor-derived questionnaire data. Figures C6 through C11 plot similar data for the motion reactivity test results (variables 23 through 41) of the squadron students.

The unweighted, student-based indices in Table III imply that for this specific VT86-AJN population, the mean or "average" student experienced airsickness on approximately 9.4 percent of the hops flown, vomited one or more times on 4.0 percent of the hops, experienced inflight performance degradation due to airsickness on 3.6 percent of the hops, and reported the presence of nervousness on 34.5 percent of the hops. The equivalent unweighted indices calculated from the instructor-furnished data indicate considerably lower mean values for the corresponding variables, with the exception of the overt vomiting symptom. This same relationship applies to the weighted indices presented in Table III. The mean value of 1.1 for the medication usage index denotes the relatively low usage of medication in the squadron. However, as mentioned in the first report (3)

such "average-student" interpretations of the Table III mean data are highly restricted by the non-Gaussian nature of the related distributions.

COMPARISON OF GRADUATED/ATTRITED STUDENT PERFORMANCE

To compare the flight and laboratory performance of the VT86-AJN students who were graduated from this squadron with those students who attrited during training in this squadron, a Kruskal-Wallis one-way analysis of variance by ranks test (2) was applied to the data associated with these two subpopulations. This nonparametric statistical approach was selected because of the non-Gaussian nature of the majority of the inflight response indices and the motion reactivity test scores. In Table IV a tabulation is made of the Kruskal-Wallis H statistic corrected for tied ranks; and, for each of the two student groups, the mean, standard deviation of the observations, standard error of the mean, and number of students in the group. To disprove the null hypothesis that the graduated and attrited students derive from the same or an identical population requires that the H statistic equal or exceed 3.84 at the .05 significance level, 6.64 at the .01 level, or 10.83 at the .001 level, assuming that H is distributed like chi square with one degree of freedom. In conformance with the analytical procedures established by the first report (3) of the series, a probability of .01 was arbitrarily selected as the minimum degree of statistical significance that would be symbolically identified in Table IV. (This choice also applies to all following tables in the report.)

Table IV indicates that there were no significant differences between the graduated and attrited student groups for any of the 20 (variables 1 through 20) Squadron VT86-AJN flight indices or for any of the 19 motion reactivity test scores (variables 23 through 41). The only difference found between the two groups involved the flight grades received during basic training in Squadron VT10. The mean flight grade score for the attrition group was slightly lower (3.01) than that for the graduate group (3.03). This lack of distinct differences between these two VT86-AJN populations for either the flight responses or the motion reactivity test scores follows that reported (3) for the graduated/attrited students during basic training in Squadron VT10. In the latter case the only difference found involved a slightly higher instructor-based flight nervousness index (variables 14 and 19) for the students who began flight training in VT10 but attrited before completing the syllabus. In both squadrons, however, the percent incidence of airsickness (variable 1) was significantly higher ($p < .05$) for the attrites.

COMPARISON OF STUDENT SUBPOPULATIONS BASED UPON AIRSICKNESS SENSITIVITY

In the first report (3) of the series it was emphasized that a long-term objective of this laboratory is to develop and validate an airsickness test battery to identify both susceptible and nonsusceptible aviation candidates. In this study, the inflight data derived from both the students and the instructors over the full course of the NFO training syllabus serve to quantitatively distinguish between those students who repeatedly suffer airsickness (high flight index scores) and those

Table IV

Results of a nonparametric Kruskal-Wallis one-way analysis of variance comparison of students who graduated from Squadron VT86-AJN with students who attrited from the squadron after beginning flight training.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	GRADUATES MEAN	S.DEV.	S ERR.	N	ATTRITES MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	4.49	7.7	10.7	1.0	114	22.0	29.2	7.5	15
2	S-VOMITING INDEX-UW	2.02	3.5	7.3	.7	114	7.1	9.9	2.5	15
3	S-P DEGRADATION INDEX-UW	2.31	2.9	5.5	.5	114	8.6	19.0	4.9	15
4	S-NERVOUSNESS INDEX-UW	1.39	33.1	29.0	2.0	114	45.5	37.4	9.7	15
5	S-MEDICATION INDEX-UW	.00	1.0	4.2	.4	114	1.2	4.7	1.2	15
6	S-AIRSICKNESS INDEX-W	3.49	3.3	4.9	.5	114	8.9	3.3	3.4	15
7	S-VOMITING INDEX-W	1.43	1.7	3.4	.3	114	2.9	4.5	1.2	15
8	S-P DEGRADATION INDEX-W	1.94	1.2	2.2	.2	114	3.6	8.5	2.2	15
9	S-NERVOUSNESS INDEX-W	1.77	12.9	12.4	1.2	114	18.8	15.5	4.0	15
10	S-MEDICATION INDEX-W	.00	1.0	4.2	.4	114	1.2	4.7	1.2	15
11	I-AIRSICKNESS INDEX-UW	1.33	4.3	7.5	.7	114	10.5	15.3	4.1	14
12	I-VOMITINC INDEX-UW	3.75	2.9	6.3	.6	114	7.9	10.6	2.8	14
13	I-P DEGRADATION INDEX-UW	.63	2.2	4.8	.4	114	6.3	14.1	3.8	14
14	I-NERVOUSNESS INDEX-UW	.01	24.0	16.4	1.5	114	30.2	23.6	6.3	14
15	I-TURBULENCE INDEX-UW	.00	30.4	15.8	1.5	114	32.5	24.6	6.6	14
16	I-AIRSICKNESS INDEX-W	1.00	2.0	3.3	.3	114	5.3	9.3	2.5	14
17	I-VOMITING INDEX-W	3.25	1.4	2.8	.3	114	3.9	5.8	1.6	14
18	I-P DEGRADATION INDEX-W	.48	.9	2.1	.2	114	2.7	6.8	1.8	14
19	I-NERVOUSNESS INDEX-W	.47	9.8	8.0	.7	114	11.8	9.7	2.6	14
20	I-TURBULENCE INDEX-W	.01	12.9	7.1	.7	114	14.4	11.9	3.2	14
21	ACADEMIC GRADES-BASIC	2.98	51.3	4.5	.4	116	49.2	5.0	1.2	18
22	FLIGHT GRADES-BASIC	7.55#	3.0	.0	.0	116	3.0	.0	.0	18
23	TMSQ1-MS HISTORY PART 1	1.48	8.0	10.6	1.0	105	12.6	13.7	3.3	17
24	TMSQ2-MS HISTORY PART 2	.76	6.4	10.0	1.0	105	6.8	6.9	1.7	17
25	TMSQ3-MS HISTORY SUM	1.16	14.4	18.1	1.8	105	19.4	18.8	4.6	17
26	TSANX-STATE/ANX.QUEST.	.55	31.5	9.8	2.7	13	37.6	15.0	6.7	5
27	TTANX-TRAIT/ANX.QUEST.	.71	27.1	3.7	1.0	13	30.6	8.4	3.8	5
28	TBVDT-BVDT TIME OF DAY	.36	9.9	1.7	.2	103	10.5	2.4	.6	17
29	TBVDR-BVDT RATER	.19	13.8	6.6	.6	106	13.6	4.9	1.2	17
30	TBVDS-BVDT SELF-RATING	.20	15.0	6.8	.7	106	14.4	7.6	1.8	17
31	TBVDP-BVDT POST-RATING	1.22	5.5	12.9	1.3	103	9.3	17.9	4.6	15
32	TVVSP1-VVIT STATIC-RIGHT	.02	120.0	7.4	1.7	18	121.3	7.3	2.7	7
33	TVVSP2-VVIT STATIC-WRONG	.02	6.2	6.3	1.5	18	5.6	5.4	2.0	7
34	TVVSP3-VVIT STATIC-OMIT	.00	2.0	2.5	.6	18	2.1	2.9	1.1	7
35	TVVDP1-VVIT DYNAMIC-RIGHT	.77	68.4	26.7	6.3	18	56.4	37.8	14.3	7
36	TVVDP2-VVIT DYNAMIC-WRONG	.77	11.5	6.1	1.4	18	8.9	5.1	1.9	7
37	TVVDP3-VVIT DYNAMIC-OMIT	.67	49.1	27.1	6.4	18	61.7	39.3	14.9	7
38	TVVIR-VVIT RATER	1.26	15.9	8.4	2.0	18	17.1	5.0	1.9	7
39	TVVIS-VVIT SELF-RATING	.00	17.7	8.1	1.9	18	17.3	7.0	2.6	7
40	TVVIP-VVIT POST-RATING	.01	7.9	10.5	2.5	18	9.4	14.9	5.6	7
41	TVVIT-VVIT TIME OF DAY	1.19	10.9	2.3	.5	18	9.9	1.7	.7	7

S = STUDENT RESPONSE DATA UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

students who rarely experience airsickness (low flight index scores). Accordingly, separation of the students into susceptible and nonsusceptible groups based upon their actual flight performance provides some direct insight into the relative merit of the individual components of the prototype motion reactivity test battery given to the students prior to their beginning NFO flight training. In the paragraphs that follow, such an approach is pursued by comparing the flight and laboratory data produced by the most susceptible students (arbitrarily defined as those students with high scores falling into the upper decile of the entire population for a given airsickness measure) with that produced by the least susceptible students (arbitrarily defined as those students who never experienced airsickness during training). In the interpretation of the data afforded by these comparisons, it must be recognized, however, that as training progresses through the various basic, advanced, and fleet readiness squadrons, the flight index level that defines the upper decile population during the early phases of training should be greater than the level that defines the upper decile population during the later phases of training. That is, natural screening of airsick-prone individuals through either attrition during basic training or selection of minimal flight stress pipelines following completion of basic training, combined with some degree of motion sickness adaptation, should result in a higher proportion of nonsusceptible students during the subsequent advanced and RAG squadron phases of the over-all training program. It would then follow that the mean values of the flight indices would be expected to fall as training progressed.

As with the first report (3) of the series, the initial comparison to be made involves the weighted airsickness index data derived from the student questionnaire (variable 6). The nonsusceptible population was defined as those students who never reported experiencing airsickness during flight training in Squadron VT86-AJN. This corresponds to airsickness index scores of 0.0 for both the unweighted (variable 1) and weighted (variable 6) responses. The susceptible or airsick population was defined as those 10 percent of the student population who had a weighted airsickness index that equaled or exceeded the 90th centile (upper decile) reference established by the normalized cumulative frequency distribution for this particular index. The student-based distribution data presented in Figure C1-B indicate that at the 90th-centile point, the weighted index score was approximately 10.0. These distribution data also indicate that the nonairsick group included approximately 44 percent (57 students) of the total squadron population (129 students) for which airsickness index scores were determined.

With these criteria serving to define the airsick susceptible and nonairsick susceptible populations, a Kruskal-Wallis one-way analysis of variance was performed on each of the response variables, the results of which are tabulated in Table V. As indicated by the significance symbols entered adjacent to the $\underline{H}$ statistic, the airsickness-related flight indices (variables 1-3, 6-8, 11-13, and 16-18) were significantly different for the two populations, which, by definition, would be expected as a result of the criterion selected to distinguish between the two populations. The medication index also shows a higher drug usage rate for the airsick group. No differences were observed for any of the nervousness-related

Table V

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never experienced airsickness during flight training with students who had a relatively high incidence of airsickness. The nonairsick group, defined as those students with a weighted airsickness index (variable 6 from the student questionnaire) equal to 0.0, represented approximately 44 percent of the total study population. The airsick group, arbitrarily established as the most sensitive 10 percent of the students, was defined as those individuals with a weighted airsickness index equal to or greater than 10.0 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONAIRSICK MEAN	NONAIRSICK S DEV.	NONAIRSICK S. ERR.	NONAIRSICK N	AIRSICK MEAN	AIRSICK S DEV	AIRSICK S. ERR.	AIRSICK N
1	S-AIRSICKNESS INDEX-UW	68.05*	.0	.0	.0	57	41.8	23.1	6.4	13
2	S-VOMITING INDEX-UW	50.03*	.0	.0	.0	57	15.9	13.3	3.7	13
3	S-P. DEGRADATION INDEX-UW	39.31*	.5	2.3	.3	57	13.7	19.7	5.5	13
4	S-NERVOUSNESS INDEX-UW	3.99	33.8	32.6	4.3	57	52.0	31.9	8.9	13
5	S-MEDICATION INDEX-UW	18.32*	.0	.0	.0	57	4.8	8.1	2.3	13
6	S-AIRSICKNESS INDEX-W	68.04*	.0	.0	.0	57	18.9	10.9	3.0	13
7	S-VOMITING INDEX-W	50.03*	.0	.0	.0	57	7.3	6.2	1.7	13
8	S-P. DEGRADATION INDEX-W	40.26*	.2	1.1	.1	57	6.0	8.7	2.4	13
9	S-NERVOUSNESS INDEX-W	4.59	12.9	12.8	1.7	57	22.3	16.1	4.5	13
10	S-MEDICATION INDEX-W	18.32*	.0	.0	.0	57	4.8	8.1	2.3	13
11	I-AIRSICKNESS INDEX-UW	50.21*	.1	1.1	.1	56	16.3	14.4	4.0	13
12	I-VOMITING INDEX-UW	43.66*	.0	.0	.0	56	12.7	11.4	3.2	13
13	I-P. DEGRADATION INDEX-UW	44.01*	.1	1.1	.1	56	11.4	13.2	3.7	13
14	I-NERVOUSNESS INDEX-UW	.13	27.9	18.9	2.5	56	26.4	20.1	5.6	13
15	I-TURBULENCE INDEX-UW	4.36	27.9	16.4	2.2	56	40.7	21.7	6.0	13
16	I-AIRSICKNESS INDEX-W	50.87*	.0	.4	.0	56	8.9	8.9	2.5	13
17	I-VOMITING INDEX-W	43.66*	.0	.0	.0	56	6.2	5.6	1.6	13
18	I-P. DEGRADATION INDEX-W	44.33*	.0	.4	.0	56	5.2	6.8	1.9	13
19	I-NERVOUSNESS INDEX-W	.06	11.5	9.3	1.2	56	10.6	8.4	2.3	13
20	I-TURBULENCE INDEX-W	2.98	11.8	7.7	1.0	56	16.1	8.8	2.4	13
21	ACADEMIC GRADES-BASIC	.49	51.3	4.6	.6	57	52.6	5.8	1.6	13
22	FLIGHT GRADES-BASIC	.07	3.0	.0	.0	57	3.0	.0	.0	13
23	TMSQ1-MS HISTORY, PART 1	6.94#	5.7	9.3	1.3	52	14.2	12.3	3.5	12
24	TMSQ2-MS HISTORY, PART 2	10.41#	4.0	6.1	.9	52	15.2	17.6	5.1	12
25	TMSQ3-MS HISTORY, SUM	12.21*	9.8	13.8	1.9	52	29.4	25.7	7.4	12
26	TSANX-STATE/ANX. QUEST.	1.51	31.0	15.6	7.8	4	37.0	7.0	3.1	5
27	TTANX-TRAIT/ANX. QUEST.	.75	29.0	3.7	1.9	4	26.2	4.1	1.8	5
28	TBVDT-BVDT TIME OF DAY	.04	9.8	1.8	.3	50	9.5	1.4	.4	12
29	TBVDR-BVDT RATER	10.47#	11.2	3.4	.5	52	17.9	8.0	2.3	12
30	TBVDS-BVDT SELF-RATING	11.59*	12.1	5.4	.7	52	20.1	6.7	1.9	12
31	TBVDP-BVDT POST-RATING	9.45#	2.6	7.6	1.1	51	10.2	11.4	3.6	10
32	TVVSP1-VVIT STATIC-RIGHT	2.05	120.0	6.7	2.4	8	124.8	3.9	1.6	6
33	TVVSP2-VVIT STATIC-WRONG	2.74	7.5	5.4	1.9	8	3.2	3.1	1.2	6
34	TVVSP3-VVIT STATIC-OMIT	.42	1.5	2.3	.8	8	1.0	2.4	1.0	6
35	TVVDP1-VVIT DYNAMIC-RIGHT	1.67	77.7	30.7	10.9	8	54.3	34.8	14.2	6
36	TVVDP2-VVIT DYNAMIC-WRONG	1.85	12.1	4.5	1.6	8	7.8	6.6	2.7	6
37	TVVDP3-VVIT DYNAMIC-OMIT	1.67	39.1	28.7	10.1	8	66.8	30.4	15.7	6
38	TVVIR-VVIT RATER	1.21	14.4	6.7	2.4	8	21.2	11.1	4.5	6
39	TVVIS-VVIT SELF-RATING	4.29	16.0	6.8	2.4	8	24.0	5.2	2.1	6
40	TVVIP-VVIT POST-RATING	3.78	5.8	12.3	4.4	8	14.5	14.1	5.8	6
41	TVVIT-VVIT TIME OF DAY	.27	9.8	1.9	.7	8	9.8	1.1	.4	6
42	ACADEMIC GRADES-ADVANCED	.03	86.8	6.6	.9	50	86.7	7.9	2.6	9
43	FLIGHT GRADES-ADVANCED	.00	3.1	.1	.0	50	3.1	.1	.0	9

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL
UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

indices nor for the instructor-based turbulence data. This applies also to the academic and flight grades received by the two groups, either in basic training or advanced training.

In the case of the 19 motion-reactivity test scores, statistical differences were found only for the three scores associated with the motion sickness history (variables 23-25) and the three scores associated with the Brief Vestibular Disorientation Test (BVDT) (variables 29-31). These same six test variables showed similar potential to distinguish between airsick susceptible and nonsusceptible students in the Squadron VT10 study (3). It should be observed that, for the majority of the remaining tests, relatively low numbers of students were included in the two populations undergoing comparison. This arises from the fact that a smaller proportion of the population were exposed to the Visual-Vestibular Interaction Test (VVIT) (variables 32-41) and the State/Trait Anxiety Index (variables 26-27) as may be deduced from the $\underline{N}$ values listed in Table III for the different motion reactivity test scores.

Table VI provides a similar comparison between students with a high (upper decile) weighted vomit index (variable 7) and students who never reported vomiting on their training flights. This latter group, representing approximately 71 percent (92 students) of the squadron population (129 students) for which student-based weighted vomit index scores were available, includes both those Table V students who were never airsick and thus never vomited, and those students who were occasionally airsick but never reported vomiting. The upper decile, as derived from the Figure C2-B distribution data, for the susceptible student group was marked by a weighted vomit index score of approximately 7.1. As indicated in Table VI, only those flight indices directly linked with airsickness, vomiting (by definition), and performance degradation served to distinguish between the two populations. In contrast to the Table V data, the airsickness medication usage index did not reflect any differences between the two groups relative to taking medication to prevent airsickness. In the case of the laboratory test scores, the only test elements found to be significantly different for the two populations involved two of the motion sickness case history scores and one element of the BVDT battery. The motion sickness history score based upon student experiences occurring after the age of 12 years (variable 24) served to distinguish between the populations. Although the motion sickness history scores based upon student experiences before the age of 12 years (variable 23) were not significantly different, the sum of the two scores (variable 25) was significantly different. The single BVDT rating that proved of value involved the score associated with the subjects' self-rating of performance (variable 30).

In like manner, a Kruskal-Wallis one-way analysis of variance was applied to two student groups distinguished by the amount of inflight performance degradation experienced as a result of airsickness. As indicated in the heading of Table VII, the nonsusceptible student group was defined by those students who never reported the incidence of performance degradation. This group represented approximately 69 percent of the total population. The susceptible group was defined by those students

Table VI

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported vomiting during flight training with students who reported a relatively high incidence of vomiting. The non-vomit group, defined as those students with a weighted vomit index (variable 7 from the student questionnaire data) equal to 0.0, represented approximately 71 percent of the study population. The vomit group was defined as those students with a weighted vomit index equal to or greater than 7.1 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONVOMIT MEAN	NONVOMIT S.DEV.	NONVOMIT S.ERR.	NONVOMIT N	VOMIT MEAN	VOMIT S.DEV.	VOMIT S.ERR.	VOMIT N
1	S-AIRSICKNESS INDEX-UW	34.10*	5.1	10.7	1.1	92	29.7	23.1	6.2	14
2	S-VOMITING INDEX-UW	104.31*	.0	.0	.0	92	21.2	8.8	2.3	14
3	S-P.DEGRADATION INDEX-UW	24.25*	1.2	3.0	.3	92	12.2	19.3	5.2	14
4	S-NERVOUSNESS INDEX-UW	.00	34.1	30.4	3.2	92	35.9	36.3	9.7	14
5	S-MEDICATION INDEX-UW	.40	.4	2.5	.3	92	.4	1.7	.4	14
6	S-AIRSICKNESS INDEX-W	35.29*	1.9	4.3	.4	92	13.6	11.7	3.1	14
7	S-VOMITING INDEX-W	104.32*	.0	.0	.0	92	10.2	3.8	1.0	14
8	S-P.DEGRADATION INDEX-W	24.10*	.5	1.4	.1	92	5.0	8.5	2.3	14
9	S-NERVOUSNESS INDEX-W	.00	13.0	12.1	1.3	92	13.7	13.8	3.7	14
10	S-MEDICATION INDEX-W	.48	.4	2.5	.3	92	.4	1.7	.4	14
11	I-AIRSICKNESS INDEX-UW	51.28*	1.1	2.6	.3	91	22.3	13.3	3.5	14
12	I-VOMITING INDEX-UW	86.01*	.0	.0	.0	91	17.7	10.1	2.7	14
13	I-P.DEGRADATION INDEX-UW	39.62*	.4	1.7	.2	91	11.4	13.7	3.7	14
14	I-NERVOUSNESS INDEX-UW	.56	24.1	17.6	1.8	91	27.1	15.6	4.2	14
15	I-TURBULENCE INDEX-UW	2.05	20.1	15.8	1.7	91	40.3	23.9	6.4	14
16	I-AIRSICKNESS INDEX-W	49.79*	.5	1.2	.1	91	10.7	8.1	2.2	14
17	I-VOMITING INDEX-W	86.00*	.0	.0	.0	91	8.3	4.5	1.2	14
18	I-P.DEGRADATION INDEX-W	30.13*	.7	.8	.1	91	4.5	6.5	1.7	14
19	I-NERVOUSNESS INDEX-W	.31	10.0	8.5	.9	91	10.3	6.4	1.7	14
20	I-TURBULENCE INDEX-W	3.35	11.0	7.3	.8	91	17.4	10.6	2.8	14
21	ACADEMIC GRADES-BASIC	.46	51.1	4.6	.5	92	52.2	4.6	1.2	14
22	FLIGHT GRADES-BASIC	.19	3.0	.0	.0	92	3.0	.0	.0	14
23	TMSQ1-MS HISTORY, PART 1	4.34	7.0	10.6	1.1	85	[illegible]	11.1	3.1	13
24	TMSQ2-MS HISTORY, PART 2	14.21*	4.6	6.0	.7	85	17.2	16.9	4.7	13
25	TMSQ3-MS HISTORY SUM	11.97*	11.6	15.4	1.7	85	29.2	24.6	6.8	13
26	TSANX-STATE/ANX.QUEST.	.38	31.6	11.2	3.6	10	34.2	8.1	3.6	5
27	TTANX-TRAIT/ANX.QUEST.	3.44	20.5	3.9	1.2	10	24.4	2.9	1.3	5
28	TBVDT-BVDT TIME OF DAY	1.15	10.1	1.9	.2	82	9.5	1.5	.4	13
29	TBVDR-BVDT RATER	3.97	12.6	5.2	.6	85	16.3	7.9	2.2	13
30	TBVDS-BVDT SELF-RATING	8.97#	13.2	6.0	.7	85	19.4	6.4	1.8	13
31	TBVDP-BVDT POST-RATING	3.47	3.4	10.6	1.2	84	12.3	19.8	6.0	11
32	TVVSP1-VVIT STATIC-RIGHT	5.72	110.1	7.8	2.0	15	125.8	2.9	1.3	5
33	TVVSP2-VVIT STATIC-WRONG	4.16	8.1	6.6	1.7	15	2.6	3.3	1.5	5
34	TVVSP3-VVIT STATIC-OMIT	2.76	2.8	2.7	.7	15	.6	1.3	.6	5
35	TVVDP1-VVIT DYNAMIC-RIGHT	.27	68.2	32.5	8.4	15	60.6	30.8	13.8	5
36	TVVDP2-VVIT DYNAMIC-WRONG	.69	12.2	5.8	1.5	15	9.0	7.2	3.2	5
37	TVVDP3-VVIT DYNAMIC-OMIT	.32	48.6	32.2	8.3	15	59.4	36.2	16.2	5
38	TVVIR-VVIT RATER	3.06	14.6	6.5	1.7	15	21.9	10.2	4.5	5
39	TVVIS-VVIT SELF-RATING	3.38	15.4	7.5	1.9	15	21.6	5.1	2.3	5
40	TVVIP-VVIT POST-RATING	4.09	7.6	13.0	3.4	15	15.4	9.7	4.4	5
41	TVVIT-VVIT TIME OF DAY	.12	10.9	2.4	.6	15	9.9	1.0	.4	5
42	ACADEMIC GRADES-ADVANCED	2.69	87.4	6.1	.7	77	90.5	5.6	1.7	11
43	FLIGHT GRADES-ADVANCED	1.11	3.1	.1	.0	77	3.0	.1	.0	11

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

Table VII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing <u>performance degradation</u> due to airsickness with students who reported a relatively high incidence of performance degradation. The non-affected group, defined as those students with a weighted performance degradation index (variable <u>8</u> from the <u>student</u> questionnaire data) equal to 0.0, represented approximately 69 percent of the study population. The affected group was defined as those students with a weighted performance degradation index equal to or greater than 5.0 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NO PER. DEGRADATION MEAN	S.DEV.	S.ERR.	N	HIGH PER. DEGRADATION MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	17.70*	5.3	10.6	1.1	89	24.6	26.7	7.7	12
2	S-VOMITING INDEX-UW	32.34*	1.6	4.9	.5	89	11.2	8.2	2.4	12
3	S-P. DEGRADATION INDEX-UW	99.47*	.0	.0	.0	89	19.7	18.8	5.4	12
4	S-NERVOUSNESS INDEX-UW	4.39	31.9	30.0	3.2	89	46.0	24.8	7.2	12
5	S-MEDICATION INDEX-UW	8.53	.6	3.4	.4	89	3.6	7.3	2.1	12
6	S-AIRSICKNESS INDEX-W	22.36*	1.9	3.7	.4	89	12.3	13.2	3.8	12
7	S-VOMITING INDEX-W	33.72*	.7	2.3	.2	89	5.3	4.1	1.2	12
8	S-P. DEGRADATION INDEX-W	99.48*	.0	.0	.0	89	8.9	7.8	2.3	12
9	S-NERVOUSNESS INDEX-W	4.30	12.2	11.8	1.3	89	18.9	11.3	3.2	12
10	S-MEDICATION INDEX-W	8.53	.6	3.4	.4	89	3.6	7.3	2.1	12
11	I-AIRSICKNESS INDEX-UW	26.10*	2.8	6.9	.7	88	15.4	13.9	4.0	12
12	I-VOMITING INDEX-UW	29.40*	1.5	5.0	.5	88	9.6	9.5	2.7	12
13	I-P. DEGRADATION INDEX-UW	45.07*	.8	3.2	.3	88	13.0	14.0	4.0	12
14	I-NERVOUSNESS INDEX-UW	.58	25.5	17.6	1.9	88	30.0	19.1	5.5	12
15	I-TURBULENCE INDEX-UW	3.43	29.2	16.5	1.8	88	40.5	19.9	5.7	12
16	I-AIRSICKNESS INDEX-W	29.36*	1.1	2.8	.3	88	7.9	8.7	2.5	12
17	I-VOMITING INDEX-W	30.82*	.6	2.2	.2	88	5.2	5.2	1.5	12
18	I-P DEGRADATION INDEX-W	48.27*	.3	1.1	.1	88	6.3	6.9	2.0	12
19	I-NERVOUSNESS INDEX-W	.28	10.5	8.6	.9	88	11.5	8.1	2.3	12
20	I-TURBULENCE INDEX-W	3.27	12.4	7.7	.8	88	17.2	9.1	2.6	12
21	ACADEMIC GRADES-BASIC	.00	51.1	4.7	.5	89	51.2	5.1	1.5	12
22	FLIGHT GRADES-BASIC	.13	3.0	.0	.0	89	3.0	.0	.0	12
23	TMSQ1-MS HISTORY PART 1	4.23	7.4	10.7	1.2	81	13.5	11.1	3.5	10
24	TMSQ2-MS HISTORY PART 2	1.16	5.4	7.4	.8	81	9.6	13.4	4.2	10
25	TMSQ3-MS HISTORY SUM	3.07	12.9	15.8	1.8	81	23.0	22.2	7.0	10
26	TSANX-STATE/ANX. QUEST.	.16	32.2	11.5	3.5	11	33.0	.0	.0	2
27	TTANX-TRAIT/ANX. QUEST.	3.22	27.5	3.9	1.2	11	22.0	.0	.0	2
28	TBVDT-BVDT TIME OF DAY	.22	9.7	1.7	.2	79	10.3	2.4	.8	10
29	TBVDR-BVDT RATER	7.47#	13.1	6.4	.7	81	18.7	7.8	2.4	11
30	TBVDS-BVDT SELF-RATING	9.12#	13.9	6.6	.7	81	21.2	6.1	1.8	11
31	TBVDP-BVDT POST-RATING	2.21	4.7	12.7	1.4	79	9.8	12.8	3.9	11
32	TVVSP1-VVIT STATIC-RIGHT	3.28	118.9	7.7	1.9	17	126.3	4.6	2.7	3
33	TVVSP2-VVIT STATIC-WRONG	1.52	7.1	6.8	1.6	17	2.7	4.6	2.7	3
34	TVVSP3-VVIT STATIC-OMIT	3.51	3.0	2.6	.6	17	.0	.0	.0	3
35	TVVDP1-VVIT DYNAMIC-RIGHT	.00	65.8	29.6	7.2	17	66.0	21.9	12.7	3
36	TVVDP2-VVIT DYNAMIC-WRONG	.41	11.4	6.0	1.5	17	13.3	4.0	2.3	3
37	TVVDP3-VVIT DYNAMIC-OMIT	.07	51.8	29.7	7.2	17	49.7	24.8	14.3	3
38	TVVIR-VVIT RATER	.55	15.5	6.4	1.6	17	17.8	5.5	3.2	3
39	TVVIS-VVIT SELF-RATING	1.13	17.1	8.1	2.0	17	22.0	6.6	3.8	3
40	TVVIP-VVIT POST-RATING	1.25	9.3	13.3	3.2	17	11.7	8.5	4.9	3
41	TVVIT-VVIT TIME OF DAY	.01	10.7	2.2	.5	17	10.4	1.2	.7	3
42	ACADEMIC GRADES-ADVANCED	.74	87.6	6.3	.7	75	85.6	6.5	2.2	9
43	FLIGHT GRADES-ADVANCED	.00	3.1	.1	.0	75	3.1	.1	.0	9

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

with a weighted performance degradation index (variable 8) that equaled or exceeded the upper decile score of approximately 5.0 as derived from the Figure C3-B distribution data. Again, of the 20 flight indices, significant differences between the two populations were found for only those measures directly linked to airsickness. No differences were found in the nervousness, medication usage, or flight turbulence indices. In the case of the laboratory test scores, significant differences were observed for only the rater and self-rating elements of the BVDT. As with the two previous comparisons, neither the academic and flight grades received during basic training nor the same grades received upon graduation from this advanced squadron served to distinguish between the two populations.

Table VIII presents a corresponding analysis based upon the weighted nervousness index scores. The upper decile used to identify the highly nervous population was marked by a weighted nervousness index score (variable 9) of approximately 32.4 as derived from the Figure C4-B distribution data. The non-nervous group, i.e., the students who reported they never experienced nervousness during flight training, included only 18 percent of the total population. As indicated by the lack of significance symbols in Table VIII, the population comparison provided by this index gives no insight whatsoever into potential differences between the student groups other than that established by the two student-based nervousness measures. It should be further observed that even though the student nervousness index (variable 9) was used to define the nervous and non-nervous populations, the instructor judgments of nervousness for the same students (variables 14 and 19) did not significantly distinguish between the two groups.

In Tables V through VIII, the classification criteria used to define the susceptible and nonsusceptible populations were based upon flight indices derived from the student judgments of their own experiences. It should be recognized that the classification criteria could also be derived from the instructor judgments of student flight performance. This is demonstrated by Table IX which is identical to Table V, with the exception that the airsick and nonairsick populations are defined by the instructor-based weighted airsickness index (variable 16) instead of the corresponding student-based index (variable 6). With this instructor-based airsickness index, the highly susceptible (upper decile) population was defined as those students who had a weighted airsickness index equal to or greater than 6.7 as derived from the Figure C1-D distribution data. The low susceptibility group for the instructor-based population subdivision (students judged by the instructors to have never experienced airsickness during training in VT86-AJN) included approximately 62 percent of the squadron population. It should be noted that the nonairsick student group defined by the students proper included only 44 percent of the population, again reflecting the general underestimation of airsickness by the instructors. As indicated by the flight index data of Table IX and in conformance with the corresponding results tabulated in Table V, significant differences between the two populations existed primarily for only the flight indices directly related to airsickness. As indicated by variables 15 and 20, however, the instructor judgments of turbulence incidence and magnitude were slightly greater for the airsick subpopulation. In the case of the laboratory test battery scores, significant differences

Table VIII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing nervousness before or during a flight with students who reported a relatively high incidence of nervousness. The non-nervous group, defined as those students with a weighted nervousness index (variable 9 from the student questionnaire data) equal to 0.0, represented approximately 18 percent of the study population. The nervous group was defined as those students with a weighted nervousness index equal to or greater than 32.0 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONNERVOUS MEAN	NONNERVOUS S.DEV.	NONNERVOUS S.ERR.	NONNERVOUS N	NERVOUS MEAN	NERVOUS S.DEV.	NERVOUS S.ERR.	NERVOUS N
1	S-AIPSICKNESS INDEX-UW	3.42	4.1	7.1	1.5	23	18.9	30.6	8.2	14
2	S-VOMITING INDEX-UW	.25	3.6	7.0	1.5	23	4.6	8.1	2.2	14
3	S-P.DEGRADATION INDEX-UW	2.90	1.5	3.7	.8	23	8.6	19.7	5.3	14
4	S-NERVOUSNESS INDEX-UW	33.75#	.0	.0	.0	23	92.9	9.7	2.6	14
5	S-MEDICATION INDEX-UW	1.64	.0	.0	.0	23	.9	3.3	.9	14
6	S-AIRSICKNESS INDEX-W	3.[illegible]	1.8	3.2	.7	23	8.1	13.8	3.7	14
7	S-VOMITING INDEX-W	.54	1.4	2.7	.6	23	2.6	4.2	1.1	14
8	S-P DEGRADATION INDEX-W	2.63	.6	1.4	.3	23	3.4	8.7	2.3	14
9	S-NERVOUSNESS INDEX-W	33.51#	.0	.0	.0	23	40.1	7.0	1.9	14
10	S-MEDICATION INDEX-W	1.64	.0	.0	.0	23	.9	3.3	.9	14
11	I-AIRSICKNESS INDEX-UW	.66	4.3	9.9	2.1	22	6.9	13.7	3.7	14
12	I-VOMITING INDEX-UW	.23	3.7	7.4	1.6	22	4.8	8.2	2.2	14
13	I-P DEGRADATION INDEX-UW	2.10	1.0	3.4	.7	22	5.2	13.3	3.6	14
14	I-NERVOUSNESS INDEX-UW	4.98	17.9	13.5	2.9	22	33.3	25.5	6.8	14
15	I-TURBULENCE INDEX-UW	.01	26.1	14.1	3.0	22	29.4	26.6	7.1	14
16	I-AIRSICKNESS INDEX-W	.86	1.7	3.5	.7	22	4.5	9.1	2.4	14
17	I-VOMITING INDEX-W	.73	1.5	2.8	.6	22	3.5	5.6	1.5	14
18	I-P.DEGRADATION INDEX-W	1.96	.4	1.5	.3	22	2.5	6.6	1.8	14
19	I-NERVOUSNESS INDEX-W	4.81	6.8	5.4	1.1	22	15.2	12.5	3.3	14
20	I-TURBULENCE INDEX-W	.00	11.1	7.1	1.5	22	12.7	12.2	3.2	14
21	ACADEMIC GRADES-BASIC	2.86	51.6	5.2	1.1	23	49.3	3.3	.9	14
22	FLIGHT GRADES-BASIC	2.96	3.0	.0	.0	23	3.0	.0	.0	14
23	TMSQ1-MS HISTORY.PART 1	.04	5.2	6.6	1.5	20	5.7	6.4	1.8	13
24	TMSQ2-MS HISTORY.PART 2	.01	7.3	8.8	2.0	20	6.6	7.0	1.9	13
25	TMSQ3-MS HISTORY.SUM	.03	12.5	14.4	3.2	20	12.3	11.6	3.2	13
26	TSANX-STATE/ANX.QUEST.	.54	34.7	13.8	6.9	4	30.8	11.1	5.0	5
27	TTANX-TRAIT/ANX.QUEST.	2.99	29.7	2.9	1.4	4	26.0	3.3	1.5	5
28	TBVDT-BVDT TIME OF DAY	.42	9.6	1.5	.3	20	9.9	2.4	.7	13
29	TBVDR-BVDT RATER	3.54	12.0	5.3	1.2	20	13.7	4.5	1.2	13
30	TBVDS-BVDT SELF-RATING	.01	14.4	7.1	1.6	20	14.2	7.0	2.0	13
31	TBVDP-BVDT POST-RATING	1.32	5.1	13.0	2.9	20	2.2	6.7	1.8	13
32	TVVSP1-VVIT STATIC-RIGHT	1.23	119.0	6.6	3.3	4	123.6	3.0	1.4	5
33	TVVSP2-VVIT STATIC-WRONG	2.23	8.5	4.9	2.5	4	4.2	2.4	1.1	5
34	TVVSP3-VVIT STATIC-OMIT	.03	1.5	3.0	1.5	4	1.2	2.7	1.2	5
35	TVVDP1-VVIT DYNAMIC-RIGHT	.24	57.0	23.3	11.7	4	63.8	34.6	15.5	5
36	TVVDP2-VVIT DYNAMIC-WRONG	.97	12.2	5.0	2.5	4	7.4	6.5	2.9	5
37	TVVDP3-VVIT DYNAMIC-OMIT	.24	59.7	25.3	12.6	4	57.8	37.1	16.6	5
38	TVVIR-VVIT RATER	.54	15.1	10.1	5.1	4	16.9	7.2	3.2	5
39	TVVIS-VVIT SELF-RATING	.02	20.5	8.6	4.3	4	20.8	7.9	3.5	5
40	TVVIP-VVIT POST-RATING	.54	11.5	17.0	8.5	4	12.8	16.7	7.5	5
41	TVVIT-VVIT TIME OF DAY	1.83	11.4	2.2	1.1	4	9.4	.9	.4	5
42	ACADEMIC GRADES-ADVANCED	.01	87.9	5.9	1.3	20	87.6	5.0	1.7	9
43	FLIGHT GRADES-ADVANCED	2.28	3.1	.1	.0	20	3.0	.1	.0	9

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

Table IX

Results of a Kruskal-Wallis one-way analysis of variance comparison of students identified by the flight instructors as never being airsick with students identified by the instructors as having a relatively high incidence of airsickness (see Table V for an equivalent comparison based upon student judgments). The non-airsick group, defined as those students with a weighted airsickness index (variable 16 from the instructor questionnaire data) equal to 0.0, represented approximately 61 percent of the total study population. The airsick group was defined as those students with a weighted airsickness index equal to or greater than 6.7 which marked the upper decile for this measure.

RESPONSE VARIABLE		H	NONAIRSICK				AIRSICK			
NO.	DESCRIPTION	STATISTIC	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	31.62*	4.1	10.4	1.2	79	33.7	25.5	7.7	11
2	S-VOMITING INDEX-UW	74.55*	.4	2.3	.3	79	21.9	10.3	3.1	11
3	S-P.DEGRADATION INDEX-UW	18.51*	1.1	2.9	.3	79	14.8	22.0	6.6	11
4	S-NERVOUSNESS INDEX-UW	1.39	32.9	30.5	3.4	79	44.4	34.5	10.4	11
5	S-MEDICATION INDEX-UW	.29	.0	3.9	.4	79	1.7	5.8	1.7	11
6	S-AIRSICKNESS INDEX-W	30.84*	1.5	3.6	.4	79	14.4	13.5	4.1	11
7	S-VOMITING INDEX-W	74.20*	.2	1.1	.1	79	9.5	4.7	1.4	11
8	S-P.DEGRADATION INDEX-W	18.05*	.4	1.2	.1	79	5.8	9.7	2.9	11
9	S-NERVOUSNESS INDEX-W	1.03	12.6	12.0	1.4	79	16.4	13.3	4.0	11
10	S-MEDICATION INDEX-W	.29	.8	3.9	.4	79	1.7	5.8	1.7	11
11	I-AIRSICKNESS INDEX-UW	88.50*	.0	.0	.0	79	29.1	9.1	2.7	11
12	I-VOMITING INDEX-UW	88.51*	.0	.0	.0	79	21.0	7.1	2.1	11
13	I-P.DEGRADATION INDEX-UW	62.18*	.0	.0	.0	79	15.2	14.9	4.5	11
14	I-NERVOUSNESS INDEX-UW	3.22	24.4	18.1	2.0	79	33.6	15.9	4.8	11
15	I-TURBULENCE INDEX-UW	10.11#	28.1	16.8	1.9	79	50.6	21.1	6.4	11
16	I-AIRSICKNESS INDEX-W	88.50*	.0	.0	.0	79	13.7	7.0	2.1	11
17	I-VOMITING INDEX-W	88.50*	.0	.0	.0	79	9.8	4.1	1.2	11
18	I-P.DEGRADATION INDEX-W	62.18*	.0	.0	.0	79	6.3	7.4	2.2	11
19	I-NERVOUSNESS INDEX-W	2.94	10.0	8.8	1.0	79	13.5	7.4	2.2	11
20	I-TURBULENCE INDEX-W	9.42#	11.9	7.8	.9	79	22.0	9.8	2.9	11
21	ACADEMIC GRADES-BASIC	.14	51.1	4.4	.5	79	51.8	4.6	1.4	11
22	FLIGHT GRADES-BASIC	.01	3.0	.0	.0	79	3.0	.0	.0	11
23	TMSQ1-MS HISTORY:PART 1	3.32	6.6	9.4	1.1	75	15.7	14.8	4.9	9
24	TMSQ2-MS HISTORY:PART 2	14.90*	4.6	6.7	.8	75	21.3	18.6	6.2	9
25	TMSQ3-MS HISTORY:SUM	10.42#	11.2	14.2	1.6	75	37.0	20.3	9.4	9
26	TSANX-STATE/ANX.QUEST.	.15	32.4	11.6	3.9	9	34.5	9.3	4.7	4
27	TTANX-TRAIT/ANX.QUEST.	1.97	28.2	4.0	1.3	9	25.0	2.9	1.5	4
28	TBVDT-BVDT TIME OF DAY	1.22	10.0	1.9	.2	73	9.4	1.5	.5	10
29	TBVDR-BVDT RATER	1.32	12.7	6.0	.7	75	14.5	6.6	2.2	10
30	TBVDS-BVDT SELF-RATING	5.08	13.3	6.0	.7	75	18.7	7.1	2.2	10
31	TBVDP-BVDT POST-RATING	4.48	3.8	9.9	1.1	74	13.9	20.5	7.3	8
32	TVVSP1-VVIT STATIC-RIGHT	5.33	118.1	8.1	2.2	14	125.8	2.9	1.3	5
33	TVVSP2-VVIT STATIC-WRONG	4.11	8.3	6.8	1.8	14	1.6	3.3	1.5	5
34	TVVSP3-VVIT STATIC-OMIT	2.33	2.6	2.6	.7	14	.6	1.3	.6	5
35	TVVDP1-VVIT DYNAMIC-RIGHT	.62	68.9	33.7	9.0	14	53.8	25.7	11.5	5
36	TVVDP2-VVIT DYNAMIC-WRONG	1.81	11.8	5.8	1.6	14	7.4	5.7	2.5	5
37	TVVDP3-VVIT DYNAMIC-OMIT	1.04	48.4	33.4	8.9	14	67.8	29.2	13.1	5
38	TVVIR-VVIT RATER	5.16	15.0	6.6	1.8	14	24.1	8.6	3.8	5
39	TVVIS-VVIT SELF-RATING	3.99	15.9	7.5	2.0	14	24.2	4.1	1.9	5
40	TVVIP-VVIT POST-RATING	2.22	8.1	13.3	3.6	14	12.8	11.5	5.1	5
41	TVVIT-VVIT TIME OF DAY	.17	10.5	2.1	.6	14	10.3	1.0	.5	5
42	ACADEMIC GRADES-ADVANCED	4.17	87.1	6.2	.8	66	91.2	9.3	3.8	6
43	FLIGHT GRADES-ADVANCED	1.47	3.1	.1	.0	66	3.0	.1	.0	6

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

between the populations were found only for two elements (variables 24 and 25) of the motion sickness case history. The capability of the three BVDT scores to distinguish ($p < .01$) between the populations based upon the student judgments of Table V was not realized with the corresponding instructor judgments. This is in contrast to the findings reported (3) for Squadron VT10 where the instructor-based data actually improved the statistical confidence in differences between the airsick and nonairsick populations established by a variety of the laboratory test scores. However, the VT86-AJN data of Table IX do have significant differences at the .05 level for two of the BVDT scores (variables 30 and 31) and two of the VVIT rating scores (variables 38 and 39).

FLIGHT AND LABORATORY DATA CORRELATIONS

To gain some insight into the relationships that may exist among the response variables during this particular phase of NFO training, the flight and laboratory data were examined, using a Spearman rank correlation analysis corrected for tied scores. The results of this analysis are presented in matrix form in Table X with the total number of data pairs associated with a given correlation coefficient within this matrix tabulated in similar form in Table XI. Table X also lists the unity value correlation of a variable with itself so as to establish the total number of observations available for analysis. To establish the statistical significance of the rank correlation coefficients, a t statistic was calculated for each relationship and a standard two-tailed student t-test table evaluation performed. Those correlations which the t-test evaluation identified as being statistically significant at the .01 and .001 levels or greater are identified accordingly in Table X. To facilitate the general interpretation of the relative strength of relationship described by the magnitude of the correlations, the definitions of Guilford (ref. 1, p. 145) as described below will be arbitrarily adopted for discussion:

Less than .20	Slight; almost negligible relationship
.20-.40	Low correlation; definite but small relationship
.40-.70	Moderate correlation; substantial relationship
.70-.90	High correlations; marked relationship
.90-1.00	Very high correlations; very dependable relationship.

In the discussion that follows, reference will be made to only those rank correlation coefficients that are statistically significant to the .01 or better level.

As with the Squadron VT10 data, the Table X rank correlation coefficients for the 20 Squadron VT86-AJN flight indices show a considerable number of significant intercorrelations as would be expected. For example, very high correlations exist between the unweighted and weighted indices for the student- based questionnaire data. The same applies within the corresponding instructor-based flight indices. Considering the three response variables that are, by definition, directly linked to

Correlat
adjusted

RESPONSE VARIABLE NO.	DESCRIPTION	1	2	3	4	5	6	7	8	9	
1	S-AIRSICKNESS INDEX-UW	1.00*									
2	S-VOMITING INDEX-UW	.67*	1.00								
3	S-P.DEGRADATION INDEX-UW	.54*	.55*	1.00							
4	S-NERVOUSNESS INDEX-UW	.08	.01	.15	1.00						
5	S-MEDICATION INDEX-UW	.29*	.24#	.18	.10	1.00					
6	S-AIRSICKNESS INDEX-W	.99*	.69*	.59*	.10	.29*	1.00				
7	S-VOMITING INDEX-W	.66*	.99*	.56*	.03	.23#	.69*	1.00			
8	S-P.DEGRADATION INDEX-W	.54*	.55*	.99*	.16	.21	.60*	.56*	1.00		
9	S-NERVOUSNESS INDEX-W	.09	.03	.15	.99	.12	.11	.04	.16	1.00	
10	S-MEDICATION INDEX-W	.29*	.24#	.18	.10	1.00	.29*	.23#	.21	.12	1.
11	I-AIRSICKNESS INDEX-UW	.71*	.80*	.51*	.07	.09	.72*	.80*	.51*	.07	.
12	I-VOMITING INDEX-UW	.63*	.92*	.54*	-.02	.17	.65*	.91*	.54*	-.01	.
13	I-P.DEGRADATION INDEX-UW	.53*	.66*	.55*	.09	.22	.57*	.65*	.57*	.10	.
14	I-NERVOUSNESS INDEX-UW	-.10	.07	-.04	.36*	.03	-.10	.08	-.02	.36*	.
15	I-TURBULENCE INDEX-UW	.20	.23#	.17	.18	.17	.20	.24#	.17	.15	.
16	I-AIRSICKNESS INDEX-W	.72*	.81*	.55*	.09	.11	.74*	.81*	.55*	.09	.
17	I-VOMITING INDEX-W	.63*	.91*	.56*	.00	.19	.65*	.92*	.56*	.02	.
18	I-P.DEGRADATION INDEX-W	.53*	.65*	.56*	.09	.22	.57*	.64*	.59*	.11	.
19	I-NERVOUSNESS INDEX-W	-.09	.05	-.04	.37*	.01	-.09	.06	-.03	.37*	.
20	I-TURBULENCE INDEX-W	.20	.25#	.10	.16	.10	.19	.25#	.17	.13	.
21	ACADEMIC GRADES-BASIC	.01	-.03	-.03	-.16	-.06	-.00	-.03	-.02	-.17	-.
22	FLIGHT GRADES-BASIC	-.05	-.05	-.06	-.15	.00	-.06	-.05	-.06	-.19	.
23	TMSQ1-MS HISTORY PART 1	.31*	.28#	.16	-.01	.23	.31*	.28#	.17	-.00	.
24	TMSQ2-MS HISTORY PART 2	.37*	.37*	.13	-.05	.15	.36*	.37*	.14	-.05	.
25	TMSQ3-MS HISTORY SUM	.40*	.37*	.16	-.02	.25#	.40*	.38*	.17	-.02	.
26	TSANX-STATE/ANX.QUEST.	.34	.17	.17	-.24	.00	.42	.14	.17	-.09	.
27	TTANX-TRAIT/ANX.QUEST.	-.09	-.45	-.23	-.51	.00	-.19	-.45	-.23	-.41	.
28	TBVDT-BVDT TIME OF DAY	.02	-.17	.13	.00	-.09	.02	-.16	.14	.01	-.
29	TBVDR-BVDT RATER	.36*	.31*	.22	.08	.21	.39*	.30*	.24	.11	.
30	TBVDS-BVDT SELF-RATING	.40*	.37*	.24#	-.10	.23	.41*	.38*	.24#	-.09	.
31	TBVDP-BVDT POST-RATING	.35*	.31*	.15	-.10	.19	.36*	.31*	.15	-.09	.
32	TVVSP1-VVIT STATIC-RIGHT	.31	.56#	.46	.35	.34	.33	.58#	.46	.32	.
33	TVVSP2-VVIT STATIC-WRONG	-.35	-.49	-.25	-.30	-.29	-.39	-.49	-.25	-.30	-.
34	TVVSP3-VVIT STATIC-OMIT	-.08	-.37	-.53#	-.26	-.19	-.06	-.38	-.53#	-.22	-.
35	TVVDP1-VVIT DYNAMIC-RIGHT	-.32	-.16	-.01	.20	-.06	-.32	-.14	-.01	.16	-.
36	TVVDP2-VVIT DYNAMIC-WRONG	-.39	-.30	-.10	-.32	-.10	-.33	-.32	-.10	-.36	-.
37	TVVDP3-VVIT DYNAMIC-OMIT	.33	.19	-.04	-.15	.06	.31	.17	-.04	-.12	.
38	TVVIR-VVIT RATER	.36	.38	.17	.06	.26	.35	.36	.17	.10	.
39	TVVIS-VVIT SELF-RATING	.47	.47	.28	.03	.27	.48	.46	.28	.09	.
40	TVVIP-VVIT POST-RATING	.47	.43	.22	.15	-.06	.52	.41	.22	.20	-.
41	TVVIT-VVIT TIME OF DAY	.21	-.08	-.02	-.47	.16	.19	-.11	-.02	-.48	.
42	ACADEMIC GRADES-ADVANCED	.15	.10	.02	-.09	-.20	.13	.10	.01	-.08	-.
43	FLIGHT GRADES-ADVANCED	-.13	-.12	.01	-.21	.05	-.14	-.14	-.00	-.22	.

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Table X

Correlation matrix for the Squadron VT86-AJN flight and laboratory data based upon the Spearman rank correla adjusted for tied ranks.

RESPONSE VARIABLE																	
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1.00																	
.12	1.00																
.07	.09	1.00															
-.01	.17	.82*	1.00														
.10	22	.71*	.68*	1.00													
.36*	.03	.07	.11	.04	1.00												
.15	.17	.21	.24#	.14	.[illegible]*	1.00											
.09	.11	.98*	.84*	.73*	.37	.22	1.00										
.02	.19	.81*	.99*	.69*	.12	.25#	.84*	1.00									
.11	.22	.71*	.67*	1.00*	.04	.14	.73*	.69*	1.00								
.37*	.01	.07	.10	.04	.97*	.37*	.00	.11	.04	1.00							
.13	.10	.22	.24#	.12	.39*	.95*	.22	.25#	.12	.36*	1.00						
-.17	-.06	-.02	.01	.01	-.20	-.07	.01	.02	.02	-.19	-.07	1.00					
-.19	.00	.02	-.07	.06	-.10	.03	.00	-.06	.06	-.13	.03	.49*	1.00				
-.00	.23	.22	.24	.19	.02	.03	.23	.23	.10	.02	.05	.12	.10	1.00			
-.05	.15	.32*	.37*	.10	-.05	.04	.34*	.37*	.10	-.02	.07	.13	.17	.50*	1.00		
-.02	.25#	.31*	.35*	.25#	-.01	.03	.34*	.34*	.24#	.00	.06	.13	.17	.89*	.81*	1.00	
-.09	.00	.11	.15	23	-.06	-.03	.00	.10	.23	-.03	-.14	.10	-.01	.26	.63#	.51	1.00
-.41	.00	-.35	-.34	-.56	-.66#	-.34	-.35	-.40	-.56	-.69#	-.39	.47	.13	.20	.27	.22	.21
.01	-.09	-.12	-.15	-.00	-.06	-.14	-.09	-.15	-.06	-.03	-.15	.06	-.05	-.03	-.29#	-.16	.11
.11	.21	.25#	.25#	.23	-.02	.03	.26#	.25#	.24	-.00	.03	-.00	-.11	.20	.25#	.26#	.50
-.09	.23	.30#	.32*	.33*	-.07	.09	.31*	.33*	.33*	-.04	.10	.07	-.01	.39*	.39*	.40*	.72*
-.09	.19	.27#	.23	.19	-.14	-.01	.26#	.21	.10	-.14	-.01	.12	.09	.39*	.38*	.46*	.50
.32	.34	.45	.43	.39	.09	.38	.46	.44	.39	.04	.40	-.14	.03	.23	.06	.22	-.26
-.30	-.29	-.42	-.37	-.29	-.09	-.21	-.41	-.39	-.29	-.05	-.23	.25	.09	-.17	-.11	-.22	.11
-.22	-.19	-.24	-.31	-.35	.00	-.33	-.27	-.30	-.35	.01	-.36	-.11	-.24	-.23	.04	-.14	.21
.16	-.06	-.13	-.22	.09	.02	-.07	-.17	-.17	.09	.04	.06	-.27	-.09	-.21	-.47	-.29	-.52
-.36	-.10	-.18	-.42	.01	-.33	-.46	-.27	-.39	.01	-.32	-.47	-.10	.19	-.37	-.56#	-.50	-.11
-.12	06	.1[illegible]	.27	-.14	.00	.15	.22	.23	-.14	.04	.03	.30	.00	-.04	.10	.04	.22
.10	.26	.20	.44	.00	-.00	.21	.31	.41	.00	-.07	.17	.29	.14	.52#	.65*	.65*	.22
.09	.27	.39	.52	.30	.06	.38	.41	.51	.38	.07	.29	.24	.31	.20	.59#	.47	.42
.20	-.06	.34	.32	.30	.06	.26	.34	.33	.30	.04	.18	.23	.19	.37	.54#	.52#	.27
-.40	.16	.[illegible]0	.01	-.06	-.31	-.07	.05	.01	-.06	-.31	-.15	.22	.29	-.16	.11	-.03	-.00
-.06	-.20	.15	.20	.03	-.14	.11	.12	.10	.01	-.11	.07	.15	.03	-.04	.10	.03	.20
-.2[illegible]	.05	-.10	-.12	-.11	-.19	-.15	-.19	-.[illegible]4	-.11	-.23	-.16	.24	.38*	.09	.09	.07	-.13

correlation coefficient

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
1.00																	
.21	1.00																
.11	-.02	1.00															
.50	.06	-.10	1.00														
.72*	.04	-.13	.57*	1.00													
.50	.26	-.02	.42*	.54*	1.00												
26	-.23	-.22	.00	.05	.15	1.00											
11	.24	.23	-.15	-.19	-.22	-.87*	1.00										
21	.05	.15	.14	.15	.14	-.50*	.10	1.00									
52	-.42	-.45	-.52*	-.42	-.57*	.33	-.27	-.32	1.00								
11	-.16	.21	-.31	-.19	-.05	-.40	.43	.13	.00	1.00							
22	.22	.27	.23	.26	.29	-.34	.27	.40	-.71*	.05	1.00						
22	.11	.35	.40*	.32	.49	.23	-.29	-.02	-.41	-.37	.05	1.00					
42	.06	.14	.27	.66*	.42	.20	-.28	-.00	-.26	-.45	.00	.60*	1.00				
27	-.25	.40	.30	.57*	.48	.04	-.19	.10	-.28	-.23	.01	.65*	.73*	1.00			
00	.00	.70*	.20	.17	.30	-.33	.25	.32	-.29	.41	.27	.10	.04	.27	1.00		
20	.60	-.06	.07	-.00	-.00	-.04	-.00	.25	-.32	.03	-.00	.13	.11	.07	.10	1.00	
13	.07	-.14	-.02	-.00	.15	.45	-.29	-.30	.21	-.29	-.32	-.07	-.24	-.31	-.36	.03	1.00

RESPONSE VARIABLE NO.	DESCRIPTION	1	2	3	4	5	6	7	8	9
1	S-AIRSICKNESS INDEX-UW	129								
2	S-VOMITING INDEX-UW	129	129							
3	S-P.DEGRADATION INDEX-UW	129	129	129						
4	S-NERVOUSNESS INDEX-UW	129	129	129	129					
5	S-MEDICATION INDEX-UW	129	129	129	129	129				
6	S-AIRSICKNESS INDEX-W	129	129	129	129	129	129			
7	S-VOMITING INDEX-W	129	129	129	129	129	129	129		
8	S-P.DEGRADATION INDEX-W	129	129	129	129	129	129	129	129	
9	S-NERVOUSNESS INDEX-W	129	129	129	129	129	129	129	129	129
10	S-MEDICATION INDEX-W	129	129	129	129	129	129	129	129	129
11	I-AIRSICKNESS INDEX-UW	128	128	128	128	128	128	128	128	128
12	I-VOMITING INDEX-UW	128	128	128	128	128	128	128	128	128
13	I-P.DEGRADATION INDEX-UW	128	128	128	128	128	128	128	128	128
14	I-NERVOUSNESS INDEX-UW	128	128	128	128	129	128	128	128	128
15	I-TURBULENCE INDEX-UW	128	128	128	128	128	128	128	128	128
16	I-AIRSICKNESS INDEX-W	128	128	129	128	128	128	128	128	128
17	I-VOMITING INDEX-W	128	128	128	128	128	128	128	128	128
18	I-P.DEGRADATION INDEX-W	128	128	128	128	128	128	128	128	129
19	I-NERVOUSNESS INDEX-W	128	128	128	128	128	128	128	128	128
20	I-TURBULENCE INDEX-W	128	128	128	128	128	128	128	128	128
21	ACADEMIC GRADES-BASIC	129	129	129	129	129	129	129	129	129
22	FLIGHT GRADES-BASIC	129	129	129	129	129	129	129	129	129
23	TMSQ1-MS HISTORY:PART 1	117	117	117	117	117	117	117	117	117
24	TMSQ2-MS HISTORY:PART 2	117	117	117	117	117	117	117	117	117
25	TMSQ3-MS HISTORY:SUM	117	117	117	117	117	117	117	117	117
26	TSANX-STATE/ANX.QUEST.	16	16	16	16	16	16	16	16	16
27	TTANX-TRAIT/ANX.QUEST.	16	16	16	16	16	16	16	16	16
28	TBVDT-BVDT TIME OF DAY	115	115	115	115	115	115	115	115	115
29	TBVDR-BVDT RATER	118	118	118	118	118	118	118	118	118
30	TBVDS-BVDT SELF-RATING	118	118	118	118	118	118	118	118	118
31	TBVDP-BVDT POST-RATING	114	114	114	114	114	114	114	114	114
32	TVVSP1-VVIT STATIC-RIGHT	23	23	23	23	23	23	23	23	23
33	TVVSP2-VVIT STATIC-WRONG	23	23	23	23	23	23	23	23	23
34	TVVSP3-VVIT STATIC-OMIT	23	23	23	23	23	23	23	23	23
35	TVVDP1-VVIT DYNAMIC-RIGHT	23	23	23	23	23	23	23	23	23
36	TVVDP2-VVIT DYNAMIC-WRONG	23	23	23	23	23	23	23	23	23
37	TVVDP3-VVIT DYNAMIC-OMIT	23	23	23	23	23	23	23	23	23
38	TVVIR-VVIT RATER	23	23	23	23	23	23	23	23	23
39	TVVIS-VVIT SELF-RATING	23	23	23	23	23	23	23	23	23
40	TVVIP-VVIT POST-RATING	23	23	23	23	23	23	23	23	23
41	TVVIT-VVIT TIME OF DAY	23	23	23	23	23	23	23	23	23
42	ACADEMIC GRADES-ADVANCED	107	107	107	107	107	107	107	107	107
43	FLIGHT GRADES-ADVANCED	107	107	107	107	107	107	107	107	107

Table XI

x indicating the number of data-pairs used in the calculation of the Table X Spearman rank correlation coef

RESPONSE VARIABLE

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
129																	
128	128																
128	128	128															
128	128	128	128														
128	128	128	128	128													
128	128	128	128	128	128												
128	128	128	128	129	128	128											
128	128	128	128	128	128	128	128										
128	129	128	128	128	128	128	128	128									
128	128	128	128	128	128	128	128	128	128								
128	128	128	128	128	128	128	128	128	128	128							
129	128	128	128	128	128	128	128	128	128	128	134						
129	128	128	128	129	128	128	128	128	128	128	134	134					
117	117	117	117	117	117	117	117	117	117	117	122	122	122				
117	117	117	117	117	117	117	117	117	117	117	122	122	122	122			
117	117	117	117	117	117	117	117	117	117	117	122	122	122	122	122		
16	16	16	16	16	16	16	16	16	16	16	18	18	18	18	18	18	
16	16	16	16	16	16	16	16	16	16	16	18	18	18	18	18	18	18
115	115	115	115	115	115	115	115	115	115	115	120	120	119	119	119	18	18
118	118	118	118	118	118	118	118	118	118	118	123	123	122	122	122	18	18
118	118	118	118	118	118	118	118	118	118	118	123	123	122	122	122	18	18
114	114	114	114	114	114	114	114	114	114	114	118	118	117	117	117	17	17
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
23	23	23	23	23	23	23	23	23	23	23	25	25	25	25	25	18	18
107	107	107	107	107	107	107	107	107	107	107	109	109	99	99	99	12	12
107	107	107	107	107	107	107	107	107	107	107	109	109	99	99	99	12	12

ation coefficients.

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
	10																
	10	120															
	10	120	123														
	10	120	123	123													
	17	115	110	110	110												
	10	25	25	25	22	25											
	10	25	25	25	22	25	25										
	10	25	25	25	22	25	25	25									
	10	25	25	25	22	25	25	25	25								
	10	25	25	25	22	25	25	25	25	25							
	10	25	25	25	22	25	25	25	25	25	25						
	10	25	25	25	22	25	25	25	25	25	25	25					
	10	25	25	25	22	25	25	25	25	25	25	25	25				
	10	25	25	25	22	25	25	25	25	25	25	25	25	25			
	10	25	25	25	22	25	25	25	25	25	25	25	25	25	25		
	12	96	99	99	96	17	17	17	17	17	17	17	17	17	17	109	
	12	96	99	99	96	17	17	17	17	17	17	17	17	17	17	109	109

3

motion sickness, i.e., airsickness, vomiting, and performance degradation due to airsickness, it can be observed in Table X that the correlations between the corresponding student and instructor indices are in the moderate to high ranges. Of these three variables, the student/instructor correlations for corresponding indices are lowest for the performance degradation measure; the highest correlations exist between the student/instructor vomit indices which would be expected for this overt symptom. There was also a substantial relationship between the students' judgment of the severity of their airsickness experiences (variable 6) and the number of times they vomited (variable 7) as marked by a positive correlation of .69. The instructor judgments of airsickness severity (variable 16) and the number of times vomiting occurred (variable 17) were even more tightly linked, having a correlation of .84. The extent of the inflight performance degradation caused by airsickness was also moderately correlated with airsickness severity for both the student and instructor ratings. These findings in Squadron VT86-AJN agree with those previously reported (3) for Squadron VT10.

The weighted nervousness indices (variables 9 and 19) had no significant correlations with any of the airsickness-related flight indices other than their unweighted counterparts. Furthermore, the correlations between the student and instructor judgments of nervousness were in the low range. Significant but low correlations also existed between the medication usage index and the student-based unweighted and weighted airsickness and vomit measures. A significant relationship between this medication index and the corresponding instructor-based airsickness and vomiting measures was not present. For the turbulence measure, small correlations existed between both the student and instructor vomit indices and the instructor ratings of nervousness.

The Table X correlation matrix can also be used to determine relationships that existed between the flight data (variables 1 through 20) and the laboratory test scores (variables 23 through 41). Although full evaluation of the relative merit of each test as a predictive measure of airsickness susceptibility must await completion of the entire data collection phase of the longitudinal study, a few points will be discussed for this advanced training squadron. First, all three of the motion sickness history test scores and all three of the BVD Test scores have low but significant correlations with the unweighted and weighted student-based measures of airsickness and vomiting. Only two of the motion sickness test scores (variables 24 and 25) have significant correlations ($p < .01$) with the instructor-based measures of airsickness and vomiting. In the case of the BVDT, all three scores were correlated with the instructor ratings of airsickness. In addition, two of the BVDT scores (variables 29 and 30) were also correlated with the instructor-based vomit indices. The element of the BVDT showing the greatest number of correlations with the student and instructor flight indices was the self-rating score (variable 30).

As may be deduced from Table XI, the number of students given the VVIT (variables 32-41) represented a relatively small segment of the squadron population. However, two elements of the static performance VVIT (see Appendix B for details) did show moderate correlations with

several of the student-based flight indices. Specifically, the VVIT score associated with the correct number of responses (variable 32) was correlated in the positive direction with the student-based measures of vomiting; the score associated with the number of responses omitted by the subject (variable 34) was correlated in the negative direction with the student-based measures of inflight performance degradation. The direction of these correlations is not, however, what would be expected from either of the two tests. That is, for the correct response item, a high score indicates good performance while for the omitted item, a high score denotes poor performance. This inconsistency was not present in the previously reported VT10 data.

Table X also indicates a moderate negative correlation between student performance on the trait anxiety index (variable 27) and the instructor ratings of nervousness. This correlation is not in the direction that would be predicted for this test. In the case of the related state anxiety index test (variable 26), no significant correlations were found with any of the flight indices. It may also be observed that the academic and flight grades given at the time of graduation from VT10 (variables 21 and 22) and at the time of graduation from VT86-AJN (variables 42 and 43) were not correlated with any of the flight indices nor with any of the laboratory test scores. The only significant correlations that existed for these variables existed between the academic and flight grades received in Squadron VT10; and between the flight grades received in the two squadrons.

The Table X correlation matrix also serves to identify significant intracorrelations that exist among the individual laboratory tests. A cursory inspection of these relationships was performed in the first report of the series (3) which involved a significantly larger population that included the students involved in the present study. Suffice to say that the strongest links within the test battery for the VT86-AJN students exist among the motion sickness history scores, the BVDT, and the main body of the VVIT.

COMPARISON OF STUDENT PERFORMANCE: BASIC VT10 VERSUS ADVANCED VT86-AJN

A generalized comparison of the airsickness problem encountered in this advanced training squadron with that experienced during basic training in Squadron VT10 can be gained from the Table I and Table II data presented in this report and from the corresponding tables from the first report (3) of the series. These tables describe airsickness incidence and severity for each hop of the squadron flight syllabus and the distribution of students having repeated airsickness during the course of training. It is to be noted that the 134 students in Squadron VT86-AJN were also members of the student population studied in the VT10 report. However, these VT86-AJN students represented only one subgroup (approximately 33 percent) within the total population of 408 students for which flight data in the initial syllabus (pre-1978) were collected during VT10 training. (Midway in the study the Squadron VT10 flight syllabus was changed and expanded to 20 hops. The airsickness study of this new flight syllabus will be presented in a subsequent report.)

The Table I data of the first report (3) indicated that during basic training in Squadron VT10, airsickness, vomiting, and inflight performance degradation due to airsickness occurred on 16.2, 6.9, and 10.7 percent, respectively, of the 5,394 hops flown by the students. The Table I data of the present study show that the same responses occurred on 8.6, 3.7, and 3.4 percent of the 1,833 hops flown by the VT86-AJN students. From this viewpoint, the incidence of airsickness difficulties fell considerably as the NFO students progressed from basic to advanced training. The same trend can be observed in comparing the Table II student distribution data presented for the two squadrons. During VT10 training, airsickness, vomiting, and performance degradation were experienced one or more times by 74.5, 39.2, and 58.6 percent, respectively, of the total student population. The corresponding VT86-AJN data indicate that these same responses were experienced by 55.2, 28.4, and 30.6 percent of the students.

These comparisons show the relative differences in the incidence of airsickness in the two squadrons. However, the comparisons are based upon group performance and do not reflect individual differences within each squadron. Although the unweighted and weighted flight indices presented in Table III of both reports provide a measure of individual student performance, the two tables cannot be directly compared since the VT10 data include a considerable number of students other than those who were assigned to advanced training in VT86-AJN. To circumvent this problem, a computer program was developed to permit direct access to the VT10 flight indices of only those students comprising the VT86-AJN study population. A Wilcoxon matched-pairs signed-ranks test (2) was then used to compare the basic and advanced training flight indices of the VT86-AJN students. The results of this test are presented in Table XII for all 20 of the flight indices. For each flight index, Table XII presents the $\underline{T}$ and $\underline{Z}$ statistics associated with the Wilcoxon test; the number of students for which there was a difference between the basic and advanced index scores; and the mean, standard deviation of the observations, standard error of the mean, and number of observations for both basic and advanced training.

As indicated by the large number of significance symbols in Table XII, there were considerable differences in the basic and advanced training flight indices of the students. For the three basic motion sickness measures, i.e., airsickness, vomiting, and performance degradation, the mean values of the indices received during advanced training in VT86-AJN were consistently lower than those received during basic training in VT10. This applies for both the unweighted and weighted flight indices and for both the student- and instructor-derived ratings. For the remaining student-based indices, i.e., nervousness and medication usage, there were no significant differences between squadrons. The instructor-based nervousness indices did reflect a difference, however, with the mean value received during advanced training being greater than that received during basic training. The same observation applies to the unweighted instructor-based turbulence index.

These Wilcoxon test results establish that there was a difference between the magnitude of the airsickness difficulties experienced by the same student population during basic and advanced training. The decrease

Table XII

Wilcoxon matched-pairs signed-ranks comparison of the flight indices received by the study population during basic training in Squadron VT10 and advanced training in Squadron VT86-AJN. For each flight index, listings are made of the T and Z statistics associated with the Wilcoxon test, the number of students for which there was a difference between the basic and advanced index scores; and the mean, standard deviation, standard error of the mean, and number of observations for both basic and advanced training.

	RESPONSE VARIABLE	WILCOXON TEST			BASIC TRAINING				ADVANCED TRAINING			
NO.	DESCRIPTION	T	Z	N	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	-1281	-5.24*	107	15.1	12.9	1.1	129	9.4	14.7	1.3	129
2	S-VOMITING INDEX-UW	-492.	-3.40*	62	7.0	10.6	.9	129	4.0	7.7	.7	129
3	S-P.DEGRADATION INDEX-UW	-422.	-6.16*	85	9.5	10.6	.9	129	3.6	8.3	.7	129
4	S-NERVOUSNESS INDEX-UW	-3400	-.60	120	34.7	26.0	2.3	129	34.5	30.9	2.7	129
5	S-MEDICATION INDEX-UW	-22.0	-2.30	16	2.1	8.0	.7	129	1.1	4.2	.4	129
6	S-AIRSICKNESS INDEX-W	-937.	-6.07*	107	7.3	7.7	.7	129	4.0	6.6	.6	129
7	S-VOMITING INDEX-W	-438.	-3.77*	62	3.6	6.2	.5	129	1.8	3.6	.3	129
8	S-P.DEGRADATION INDEX-W	-344.	-6.50*	85	4.7	6.1	.5	129	1.5	3.6	.3	129
9	S-NERVOUSNESS INDEX-W	-2963	-1.33	117	14.2	11.2	1.0	129	13.5	12.9	1.1	129
10	S-MEDICATION INDEX-W	-22.0	-2.38	16	2.1	8.0	.7	129	1.1	4.2	.4	129
11	I-AIRSICKNESS INDEX-UW	-838.	-4.22*	84	9.2	11.4	1.0	128	5.0	8.8	.8	128
12	I-VOMITING INDEX-UW	-464.	-3.59*	62	6.8	10.3	.9	128	3.5	7.0	.6	128
13	I-P.DEGRADATION INDEX-UW	-304.	-5.02*	65	7.1	10.0	.9	128	2.6	6.5	.6	128
14	I-NERVOUSNESS INDEX-UW	2392.	-3.70*	124	17.3	14.3	1.3	128	24.7	17.3	1.5	128
15	I-TURBULENCE INDEX-UW	2055.	-4.93*	128	21.7	12.9	1.1	128	30.7	16.8	1.5	128
16	I-AIRSICKNESS INDEX-W	-876.	-4.05*	84	4.4	6.4	.6	128	2.3	4.5	.4	128
17	I-VOMITING INDEX-W	-456.	-3.65*	62	3.3	5.3	.5	128	1.6	3.3	.3	128
18	I-P.DEGRADATION INDEX-W	-318.	-5.03*	66	3.1	4.9	.4	128	1.1	3.0	.3	128
19	I-NERVOUSNESS INDEX-W	2224.	-4.12*	124	6.5	5.7	.5	128	10.0	8.1	.7	128
20	I-TURBULENCE INDEX-W	3265.	-1.92	127	11.2	7.0	.6	128	13.0	7.7	.7	128

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

in the incidence and degree of airsickness as the students progressed from basic to advanced training would be explained in part by the capability of individuals to adapt to motion stress over a period of time. However, consideration must be given also to the comparative evaluation of the magnitude of the actual motion stress associated with each squadron's flight syllabus. It is expected that the additional data to be collected in the course of the longitudinal study will give some insight into the relative contributions of adaptation and flight syllabus motion stress to airsickness incidence.

A further point of operational significance involves the prediction of student airsickness experiences as he progresses through the entire NFO training program. That is, will a specific student who has a problem with airsickness during basic training continue to face the same problem during advanced training? Or, conversely, will those students who were never airsick during basic training enjoy this immunity during advanced training? As a preliminary evaluation of these questions on a total population basis, a Spearman rank correlation analysis corrected for tied observations was applied across the basic and advanced training flight indices received by the 129 VT86-AJN students. The resulting rank correlation coefficients are presented in matrix form at the top in Table XIII, with the number of data-pairs involved in each calculation listed correspondingly at the bottom.

An examination of the principal diagonal of Table XIII shows that statistically significant correlations between basic and advanced training were present for all ten of the student-based flight indices. The correlation coefficients, ranging from .40 to .64, indicate a substantial relationship between sickness measures in the two different squadrons. For the three principal motion sickness measures, the correlation coefficients associated with the weighted measure (variables 6-8) were slightly greater than those associated with the unweighted measures (variables 1-3). In the case of the 10 instructor-based flight indices, the principal diagonal data show that significant correlations were present only for the three principal motion sickness measures (variables 11-13 and 16-18). These correlation coefficients, ranging from .39 to .50, also show a substantial relationship between basic and advanced training performance. For the instructor-based nervousness indices, there were no significant correlations across squadrons. No correlations were found for the turbulence indices, which is as would be expected from the nature of this parameter. For the grade data the only significant correlation found involved the flight grades received in basic training and the flight grades received in advanced training.

The Table XIII matrix, by definition, also describes the interrelationship that exists between a given advanced training flight index and each of the flight indices received during basic training. Again, most of these interindex correlations involve the three primary airsickness measures. In general, the correlations that exist along the principal diagonal are greater than those that exist to either side in the matrix. No further interpretation of these data will be attempted until completion of the entire data collection phase of the longitudinal study.

Table XIII

Correlation matrix for the flight indices received by the study population during basic training in Squadron VT10 and advanced training in Squadron VT86-AJN based upon the Spearman rank correlation coefficient adjusted for tied ranks. Correlation coefficients at top and number of data-pairs at bottom.

ADVANCED SQUADRON RESPONSE VARIABLE NO.	DESCRIPTION	BASIC SQUADRON RESPONSE VARIABLE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	S-AIRSICKNESS INDEX-UW	.51*	.53*	.48*	.10	.34*	.55*	.54*	.55*	.25#	.34*	.49*	.53*	.52*	.11	.29*	.53*	.53*	.53*	.10	.25#	.01	-.05
2	S-VOMITING INDEX-UW	.44*	.54*	.38*	.06	.34*	.47*	.54*	.42*	.12	.34*	.47*	.52*	.44*	.09	.16	.48*	.52*	.46*	.09	.13	-.03	-.05
3	S-P DEGRADATION INDEX-UW	.36*	.35*	.40*	.20	.30*	.39*	.34*	.42*	.24#	.30*	.32*	.36*	.25#	.09	.13	.33*	.34*	.25#	.08	.04	-.03	-.06
4	S-NERVOUSNESS INDEX-UW	.26#	.15	.26#	.64*	.13	.25#	.15	.24#	.62*	.13	.17	.12	.11	.28#	.17	.17	.11	.11	.30*	.20	-.16	-.15
5	S-MEDICATION INDEX-UW	.27#	.28#	.20	.17	.61*	.28#	.29*	.23#	.20	.61*	.26#	.22	.28#	.06	.17	.27#	.22	.29*	.03	.15	-.06	.00
6	S-AIRSICKNESS INDEX-W	.54*	.56*	.52*	.19	.36*	.58*	.57*	.53*	.26#	.36*	.52*	.56*	.54*	.12	.29*	.56*	.55*	.55*	.11	.26#	-.00	-.06
7	S-VOMITING INDEX-W	.45*	.55*	.39*	.07	.35*	.48*	.55*	.42*	.12	.35*	.48*	.53*	.44*	.02	.16	.49*	.53*	.46*	.08	.13	-.03	-.05
8	S-P DEGRADATION INDEX-W	.37*	.36*	.41*	.20	.32*	.40*	.35*	.43*	.24#	.32*	.33*	.37*	.27#	.10	.13	.34*	.36*	.25#	.09	.04	-.02	-.06
9	S-NERVOUSNESS INDEX-W	.26#	.15	.27#	.62*	.15	.25#	.15	.25#	.62*	.15	.17	.12	.13	.29*	.16	.17	.11	.12	.31*	.13	-.17	-.19
10	S-MEDICATION INDEX-W	.27#	.28#	.20	.17	.61*	.28#	.29*	.23#	.20	.61*	.26#	.22	.28#	.06	.17	.27#	.22	.29*	.03	.13	-.06	.00
11	I-AIRSICKNESS INDEX-UW	.41*	.44*	.36*	.06	.18	.43*	.44*	.38*	.11	.18	.39*	.46*	.39*	.02	.13	.40*	.45*	.40*	.03	.11	-.02	.02
12	I-VOMITING INDEX-UW	.39*	.46*	.33*	.01	.25#	.42*	.47*	.38*	.06	.25#	.42*	.50*	.39*	.04	.13	.43*	.50*	.40*	.03	.10	.01	-.07
13	I-P DEGRADATION INDEX-UW	.41*	.42*	.40*	.09	.30*	.42*	.42*	.41*	.15	.30*	.39*	.41*	.40*	-.01	.06	.41*	.41*	.41*	-.02	-.01	.01	.06
14	I-NERVOUSNESS INDEX-UW	-.01	-.02	.03	.13	.02	-.00	-.03	.01	.10	.02	.02	-.01	-.05	.12	.07	.07	-.02	-.05	.14	.09	-.20	-.10
15	I-TURBULENCE INDEX-UW	-.02	.11	-.01	.10	.18	-.00	.11	.02	.08	.18	.08	.13	.07	-.01	.16	.09	.11	.07	-.02	.17	-.07	.03
16	I-AIRSICKNESS INDEX-W	.43*	.46*	.30*	.09	.20	.44*	.45*	.40*	.14	.20	.41*	.47*	.41*	.03	.13	.42*	.47*	.42*	.03	.10	.01	.00
17	I-VOMITING INDEX-W	.42*	.48*	.34*	.02	.27#	.43*	.48*	.39*	.08	.27#	.43*	.51*	.40*	.03	.14	.44*	.50*	.41*	.02	.11	.02	-.06
18	I-P DEGRADATION INDEX-W	.42*	.43*	.40*	.09	.30*	.43*	.42*	.42*	.14	.30*	.40*	.41*	.41*	-.01	.07	.42*	.41*	.42*	-.02	-.01	.02	.06
19	I-NERVOUSNESS INDEX-W	-.02	-.04	.03	.12	.01	-.00	-.04	.01	.09	.01	.01	-.02	-.05	.12	.08	.01	-.02	-.06	.14	.09	-.19	-.13
20	I-TURBULENCE INDEX-W	-.02	.09	-.04	.00	.22	-.00	.09	-.00	.06	.22	.07	.10	.03	.05	.11	.08	.09	.03	.03	.11	-.07	.03
21	ACADEMIC GRADES	-.06	.05	-.09	-.11	-.10	-.03	.05	-.06	-.10	-.10	-.05	.07	.02	-.12	.15	-.04	.07	.03	-.15	.20	.15	.03
22	FLIGHT GRADES	-.06	-.10	-.03	-.04	-.06	-.11	-.09	-.03	-.02	-.06	-.11	-.07	-.11	-.21	-.01	-.12	-.07	-.12	-.24	-.06	.24	.38*

S = STUDENT RESPONSE DATA UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

ADVANCED SQUADRON RESPONSE VARIABLE NO.	DESCRIPTION	BASIC SQUADRON RESPONSE VARIABLE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	S-AIRSICKNESS INDEX-UW	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
2	S-VOMITING INDEX-UW	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
3	S-P DEGRADATION INDEX-UW	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
4	S-NERVOUSNESS INDEX-UW	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
5	S-MEDICATION INDEX-UW	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
6	S-AIRSICKNESS INDEX-W	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
7	S-VOMITING INDEX-W	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
8	S-P DEGRADATION INDEX-W	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
9	S-NERVOUSNESS INDEX-W	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
10	S-MEDICATION INDEX-W	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
11	I-AIRSICKNESS INDEX-UW	128	128	128	128	128	128	128	129	128	129	129	128	128	129	129	128	129	128	128	128	128	128
12	I-VOMITING INDEX-UW	128	129	129	128	129	129	129	129	[illegible]	129	129	129	128	129	129	128	129	128	128	129	128	128
13	I-P DEGRADATION INDEX-UW	128	129	129	128	129	128	128	128	129	128	129	129	128	129	129	128	129	128	128	128	128	128
14	I-NERVOUSNESS INDEX-UW	128	128	128	128	129	128	128	128	128	128	129	128	128	128	129	128	129	128	129	128	128	128
15	I-TURBULENCE INDEX-UW	128	128	129	128	129	128	128	129	128	128	129	128	128	128	128	128	128	128	128	129	128	128
16	I-AIRSICKNESS INDEX-W	128	128	128	128	128	128	128	128	128	129	129	128	128	128	128	128	129	128	128	128	128	128
17	I-VOMITING INDEX-W	128	128	128	128	128	128	128	129	128	129	129	128	128	129	129	128	128	128	128	128	128	128
18	I-P DEGRADATION INDEX-W	128	128	128	128	129	128	128	129	129	129	128	128	128	129	129	128	128	128	128	128	128	128
19	I-NERVOUSNESS INDEX-W	128	128	128	129	128	128	129	129	128	129	129	128	128	128	129	128	129	128	128	128	128	128
20	I-TURBULENCE INDEX-W	128	128	128	128	128	128	128	128	128	128	128	128	128	128	129	128	129	128	128	128	128	128
21	ACADEMIC GRADES	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109
22	FLIGHT GRADES	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109

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APPENDIX A

Brief Description of Individual Hops Comprising the Advanced Training Squadron VT86-AJN Flight Syllabus (Pre-1978 Flight Syllabus)

VT86-AJN (Pre-1978 Syllabus)

LL-1, -2, -3, -4	Low Level Navigation: Primarily straight and level flight - no acrobatics (LL-4 check flight)
RN-1, -2, -3, -4	Radar Navigation: Primarily straight and level flight - no acrobatics RN-4 check flight)
RA-1, -2, -3	Radar Analysis: Both low and high level terrain identification Primarily straight and level - no acrobatics (RA-3 check flight)
AN-1	Airways Navigation: Primarily straight and level flight - no acrobatics
D-1, -2	TA-4J Familiarization: D-2 has wingover, aileron rolls, barrel rolls

All hops flown in T-39D with the exception of D-1 and -2 which were in the TA-4J.

APPENDIX B

Brief Description of Laboratory Tests Comprising the 1977-1978 Prototype Motion Sickness Sensitivity Test Battery

Variable No.	Symbol Code	Test Description
23 24 25	TMSQ1 TMSQ2 TMSQ3	Two-part motion sickness history form describing motion sickness incidence and exposure level. TMSQ1 summarizes the history before the age of 12 and has a minimum value of 0.0 denoting no problems and a maximum value of 180 denoting high susceptibility. TMSQ2 pertains to motion sickness experience following age 12 with the same minimum and maximum values. TMSQ3 is the numerical sum of the TMSQ1 and TMSQ2 scores. For details, see Reason, J. T., An investigation of some factors contributing to individual variation in motion sickness susceptibility. FPRC Committee Report 1277. London: Ministry of Defence, 1968.
26 27	TSANX TTANX	This State-Trait Anxiety Inventory is comprised of two self-report scales. The State Anxiety scale (TSANX) reqires the individual to report how he feels at that particular moment in time, while the Trait Anxiety Scale (TTANX) requires the individual to report how he generally feels. Both scales have a minimum score of 20, denoting minimum anxiety and a maximum score of 80 denoting maximum anxiety. For details, see Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E., _STAI Manual for the State-Trait Anxiety Inventory_. Palo Alto, CA: Consulting Psychologists Press, 1970.
28 29 30 31	TBVDT TBVDR TBVDS TBVDP	Brief Vestibular Disorientation Test (BVDT) involving cross-coupled angular acceleration stimuli produced by paced head motions on a rotating chair. TBVDT denotes the time of day the test was given based upon a 24-hour decimal clock. TBVDR is the test score given by the rating panel and has a minimum value of 6 denoting no motion symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the BVDT, each subject rated his own reactions to the test coded as TBVDS with a minimum score of 7 indicating no reaction and a maximum score of 49 denoting high reaction. A report of aftereffects was obtained from the subject 24 hours later and coded as TBVDP with a minimum score of 0 denoting no aftereffects and a maximum score of 180 denoting a high level of aftereffects. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

Variable No.	Symbol Code	Test Description
32 33 34	TVVSP1 TVVSP2 TVVSP3	These scores pertain to the task performance element of the Visual-Vestibular Interaction Test (VVIT). The tasks involve the visual scan, acquisition and identification of a complex numerical display. Under static conditions, TVVSP1 denotes the number of correct responses, TVVSP2 the number of incorrect responses, and TVVSP3 the number of omitted responses.
35 36 37	TVVDP1 TVVDP2 TVVDP3	The dynamic performance test scores TVVDP1, TVVDP2, and TVVDP3 describe the same response scores recorded while the subject undergoes passive sinusoidal rotation. For both the static and dynamic performance tests, the minimum scores within a given response category are 0 and 129, respectively, with the further condition that sum of the correct, incorrect, and omitted scores must total 129. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.
38 39 40 41	TVVIR TVVIS TVVIP TVVIT	These scores pertain to the motion sickness symptom rating element of the Visual-Vestibular Interaction Test (VVIT). TVVIR is the test score given by the rating panel and has a minimum value of 6 denoting no motion sickness symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the VVIT, each subject rated his own reaction to the test, which was coded as TVVIS, with a minimum score of 7 denoting no reaction and a maximum score of 70 denoting high reaction. A report of aftereffects was obtained from the subject approximately 24 hours later and coded as TVVIP with a minimum score of 0 denoting no aftereffects. TVVIT denotes the time of day the test was administered based upon a 24-hour decimal clock. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

APPENDIX C

Normalized Cumulative Frequency Distribution of Flight Indices
and Laboratory Test Scores for the Squadron VT86-AJN Population
(Pre-1978 Flight Syllabus)

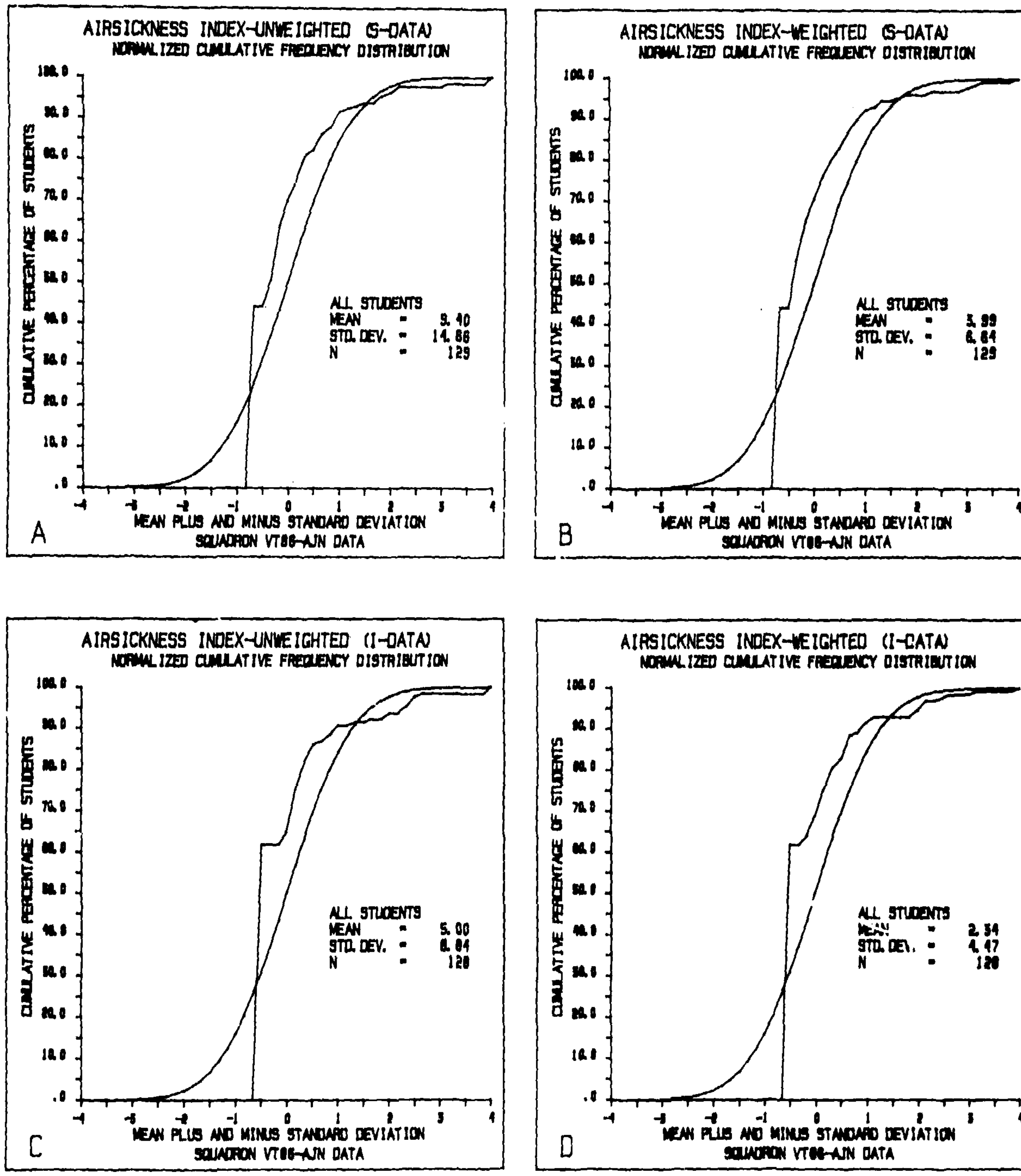


Figure C1

Normalized cumulative frequency distributions of unweighted (A) and weighted (B) airsickness indices calculated from the student questionnaire data and the equivalent unweighted (C) and weighted (D) indices calculated from the instructor data. Each plot contains the distribution of the observed data (irregular curve) and an equivalent Gaussian distribution (smooth curve) with the same mean and standard deviation as the observed data. The weighted student data (B) indicate that approximately 45 percent of the students never reported experiencing airsickness during flight training in this squadron. The same data show that a weighted airsickness index of approximately 10.0 defined the upper decile (most sensitive students) of the distribution.

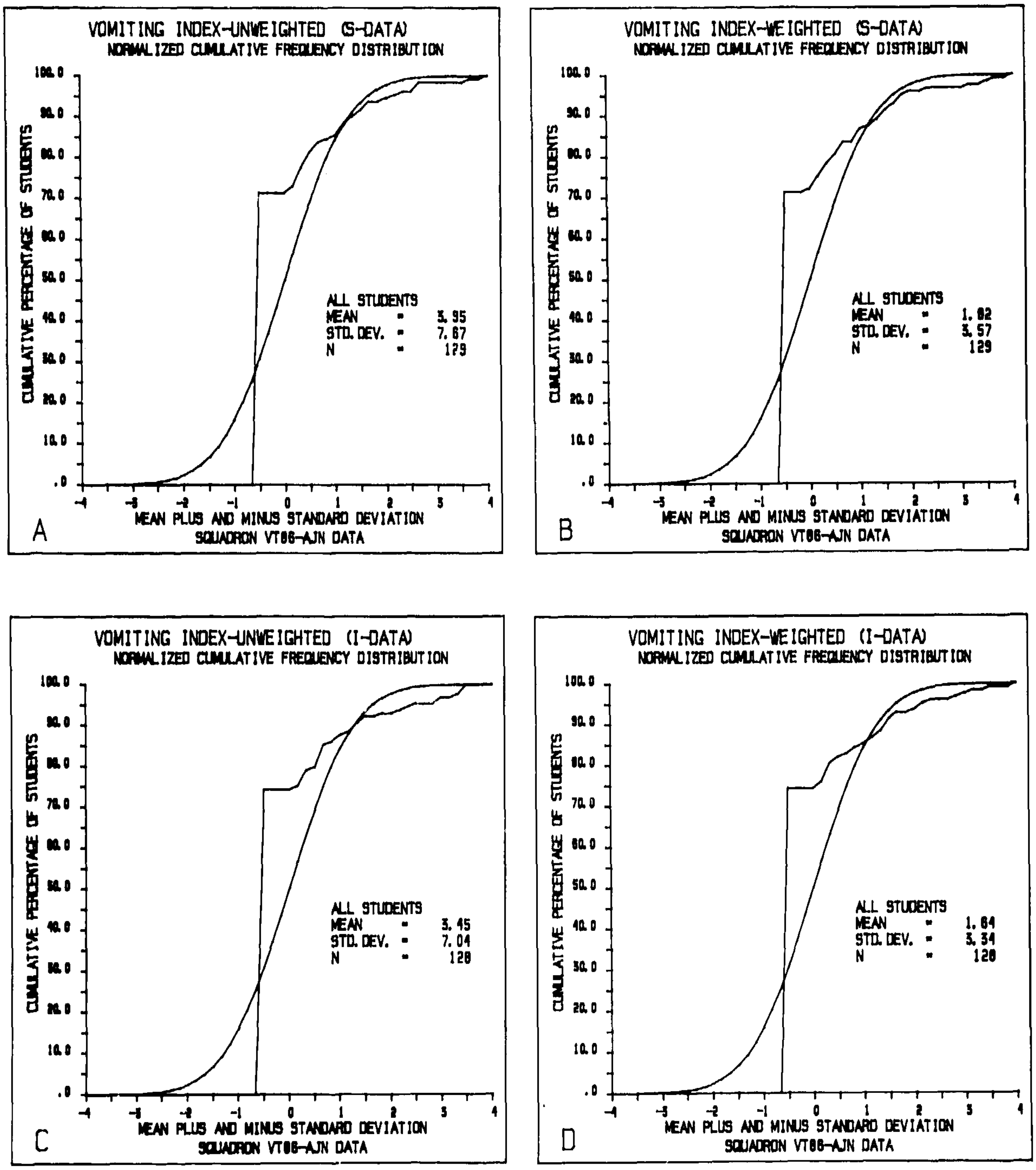


Figure C2

Normalized cumulative frequency distributions of unweighted and weighted vomit indices following the Figure C1 format. The weighted student data (B) indicate that approximately 72 percent of the students never vomited during flight training. A weighted index of approximately 7.1 defined the upper decile for this distribution.

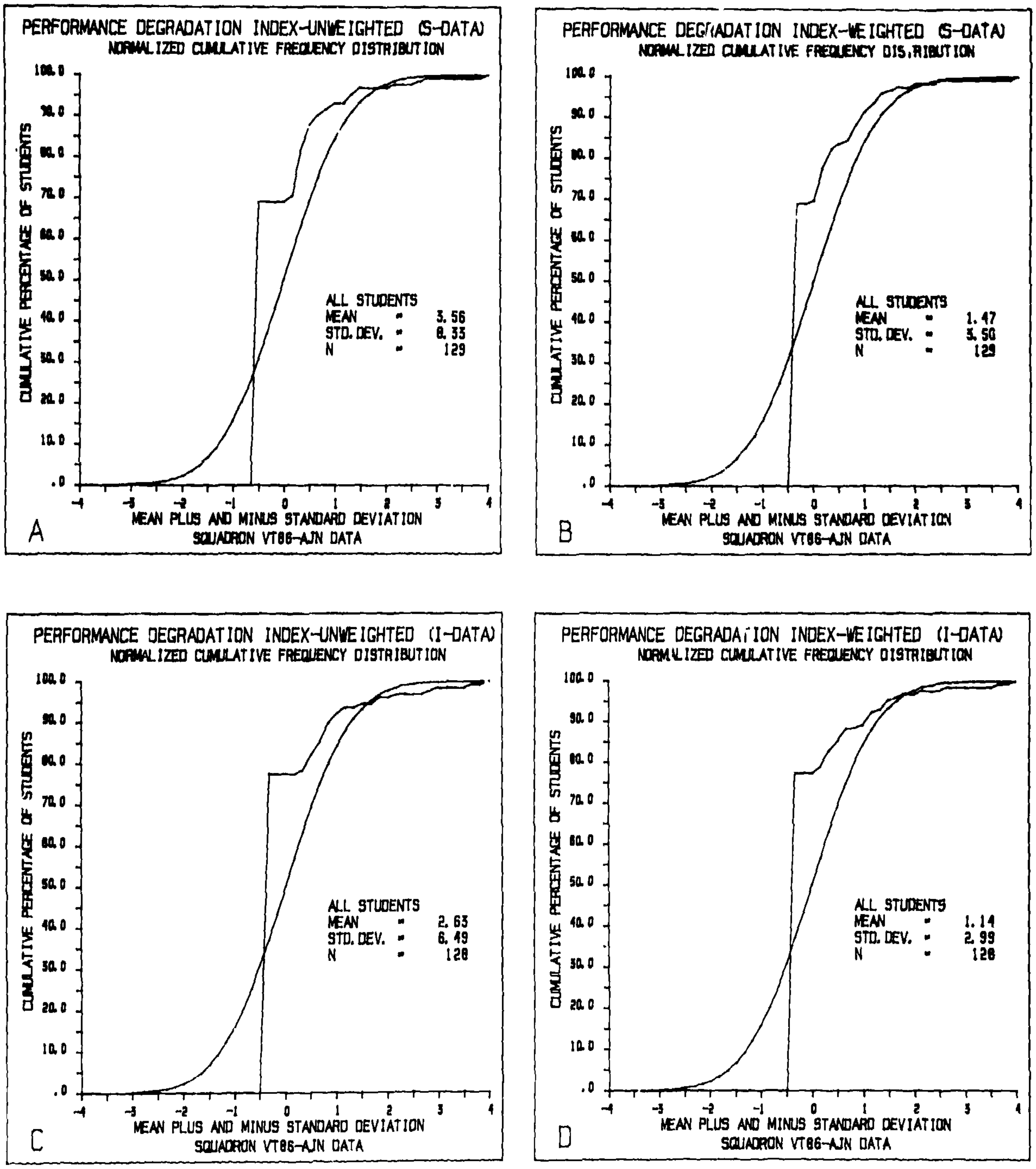


Figure C3

Normalized cumulative frequency distributions of unweighted and weighted performance degradation indices following the Figure C1 format. The weighted student data (B) indicate that approximately 69 percent of the students reported never experiencing performance degradation due to airsickness during flight training. A weighted index of approximately 5.0 defined the upper decile for this distribution.

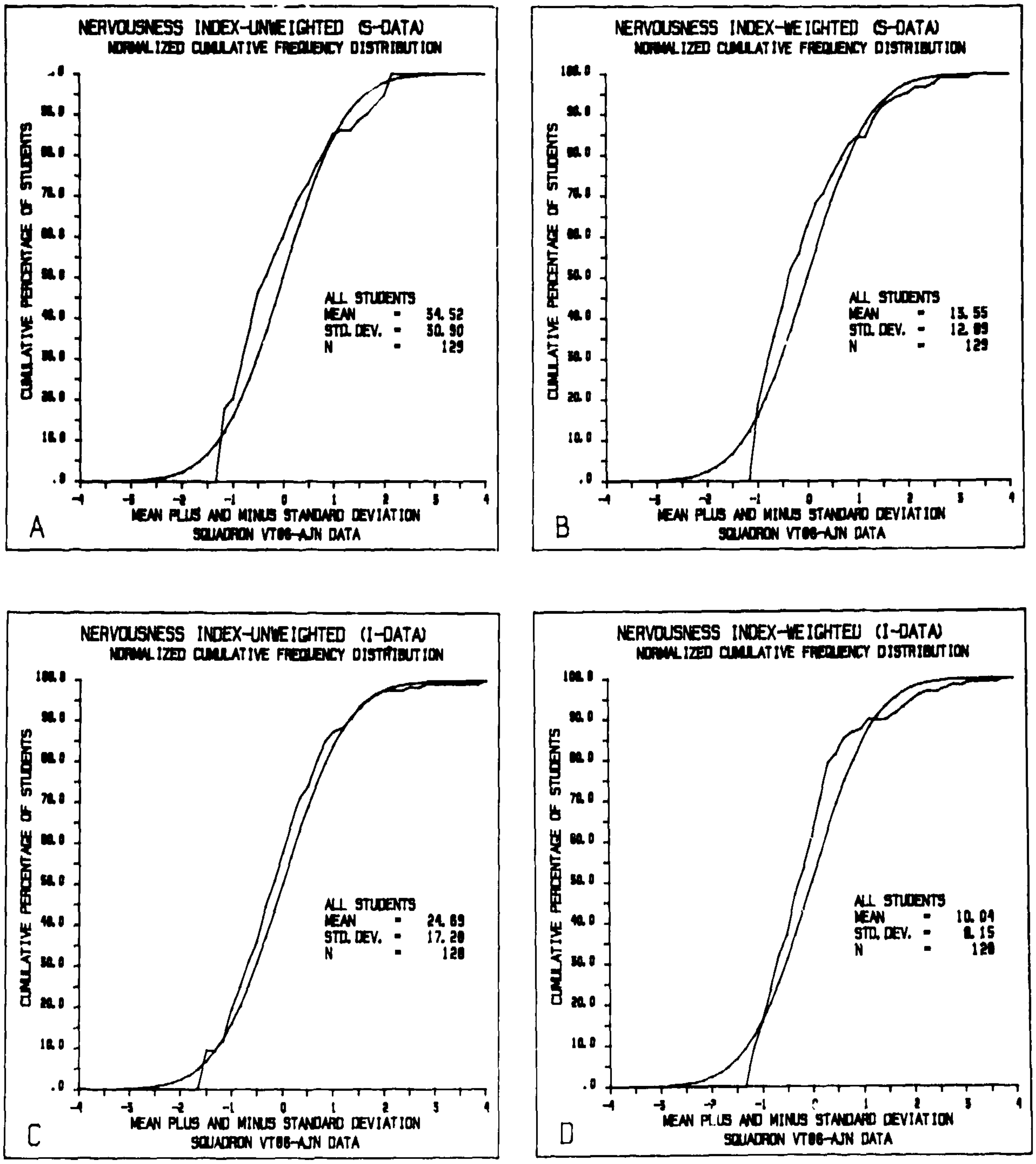


Figure C4

Normalized cumulative frequency distributions of unweighted and weighted nervousness indices following the Figure C1 format. The weighted student data (B) indicate that only 19 percent of the students reported never experiencing nervousness prior to or during a flight. A weighted index of approximately 32.0 defined the upper decile for this distribution.

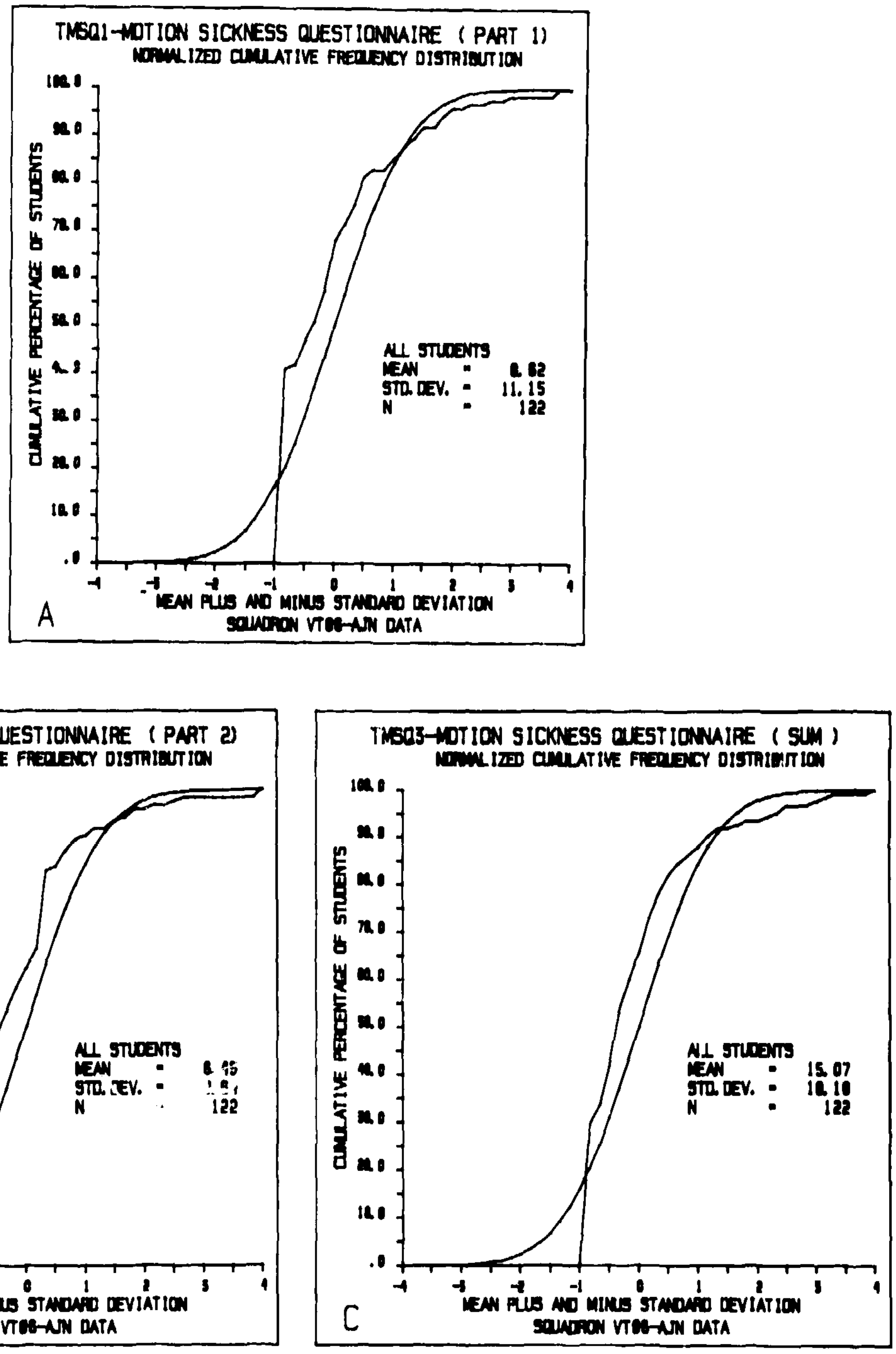
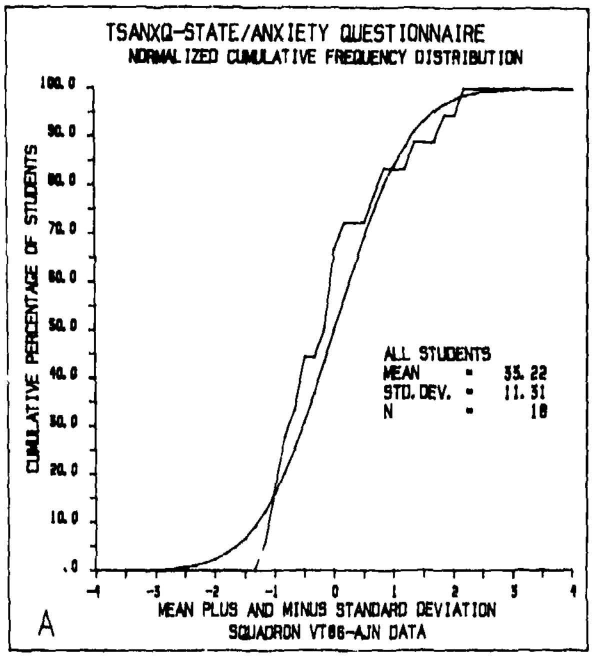


Figure C5

Normalized cumulative frequency distributions of the student-derived medication usage index (A) and the instructor-derived unweighted (B) and weighted (C) turbulence indices. The medication data again emphasize the relatively small number of students reporting the use of airsickness drugs during training. The turbulence data, as compared to the other indices, more closely approach a normal distribution.



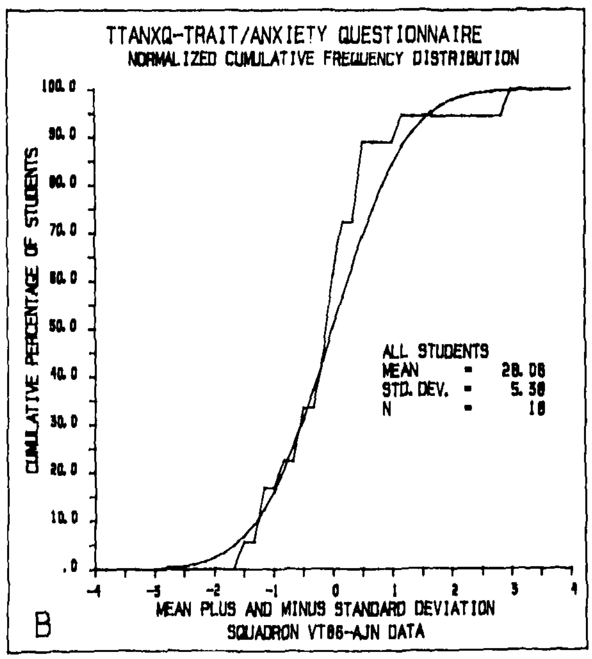


Figure C6

Normalized cumulative frequency distributions (irregular curve) of the three motion sickness history scores derived from the study population. Each plot also shows the equivalent distribution of a theoretical Gaussian population (smooth curve) with the same mean and standard deviation as the related laboratory test scores.

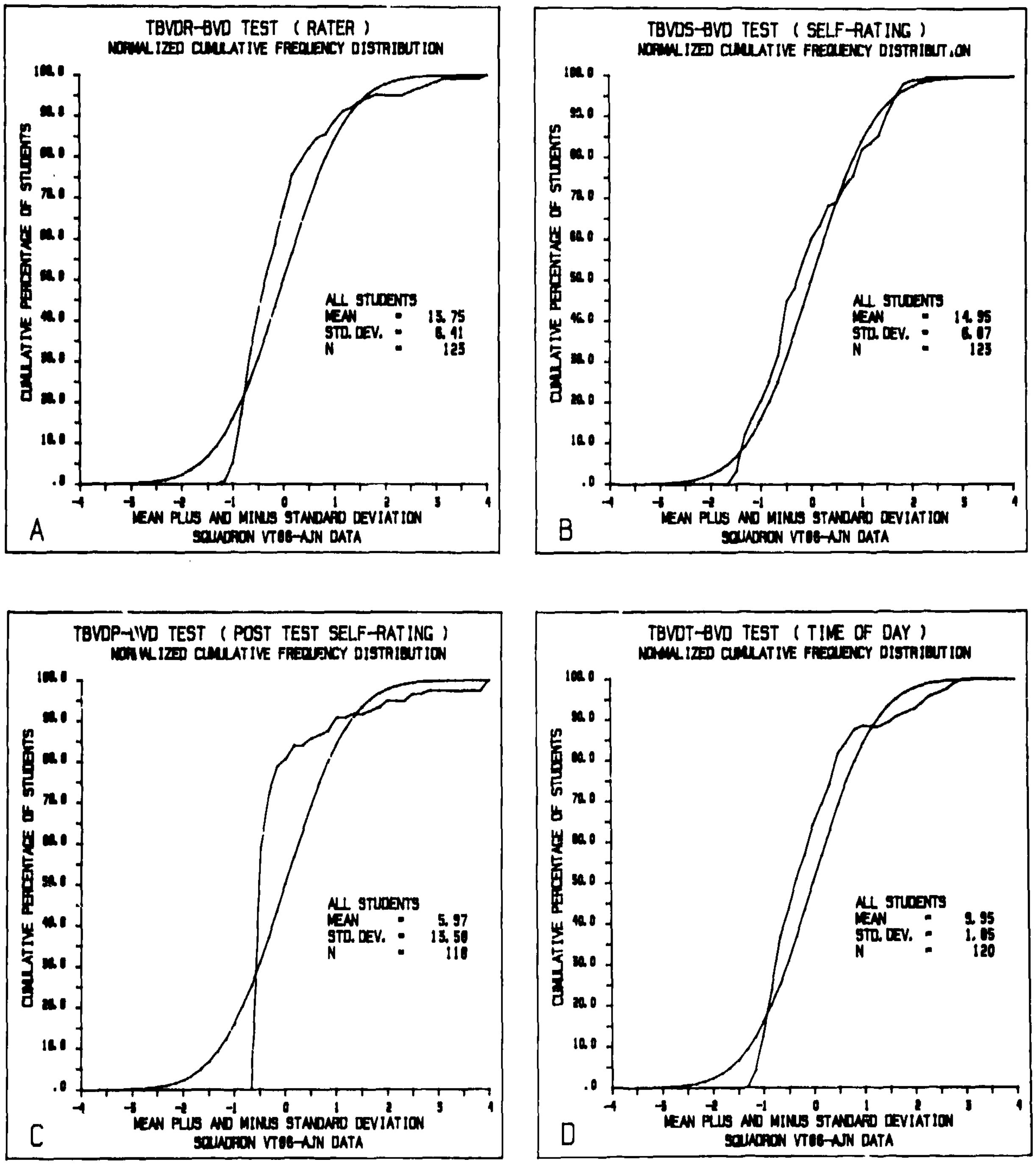


Figure C7

Normalized cumulative frequency distributions of state/anxiety (A) and trait/anxiety (B) test scores based upon the observed data (irregular curves) and a theoretical Gaussian population (smooth curves) having the same mean and standard deviation as the observed test scores.

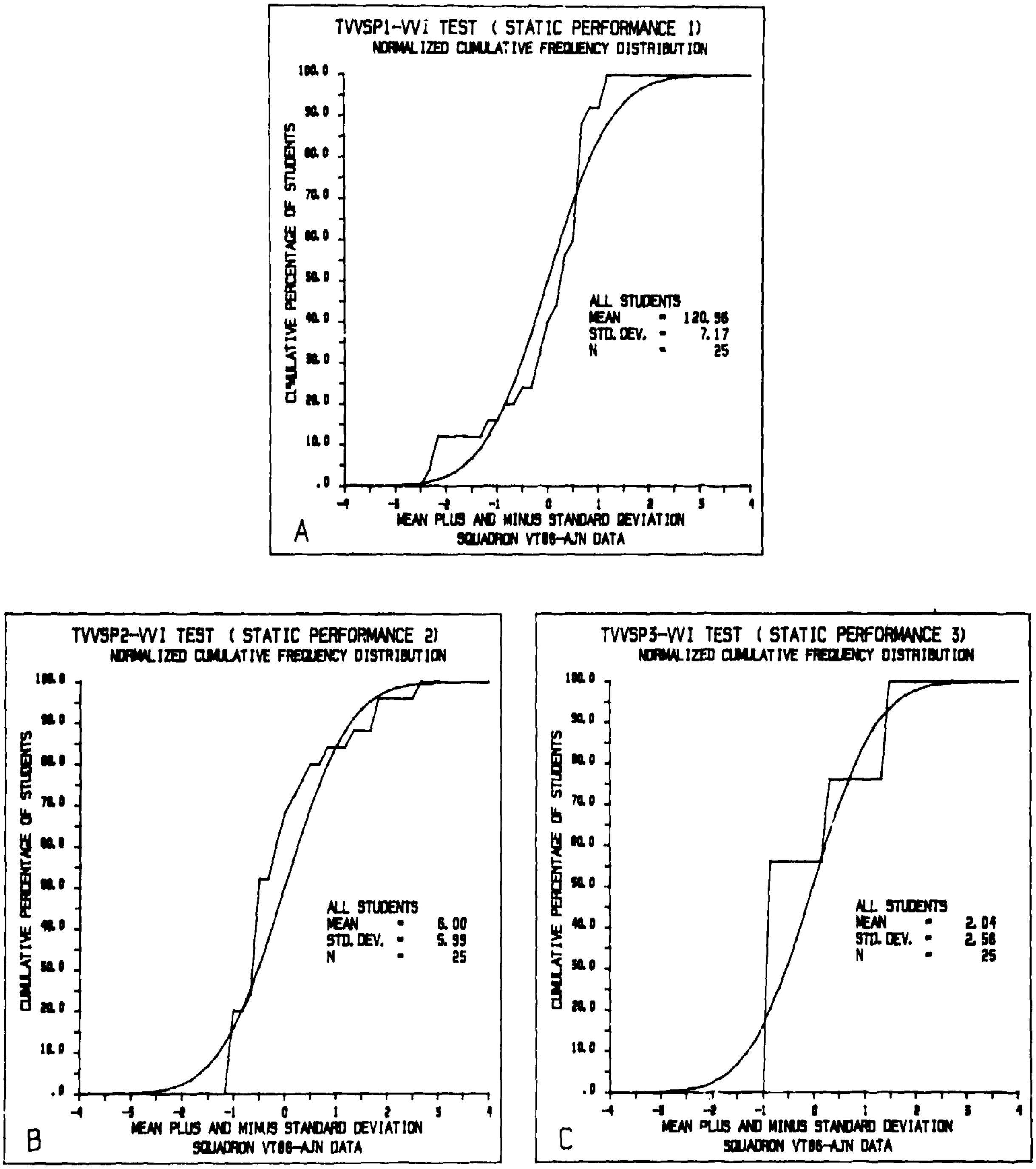


Figure C8

Normalized cumulative frequency distributions of the Brief Vestibular Disorientation Test (BVDT) scores (irregular curves) and equivalent theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations.

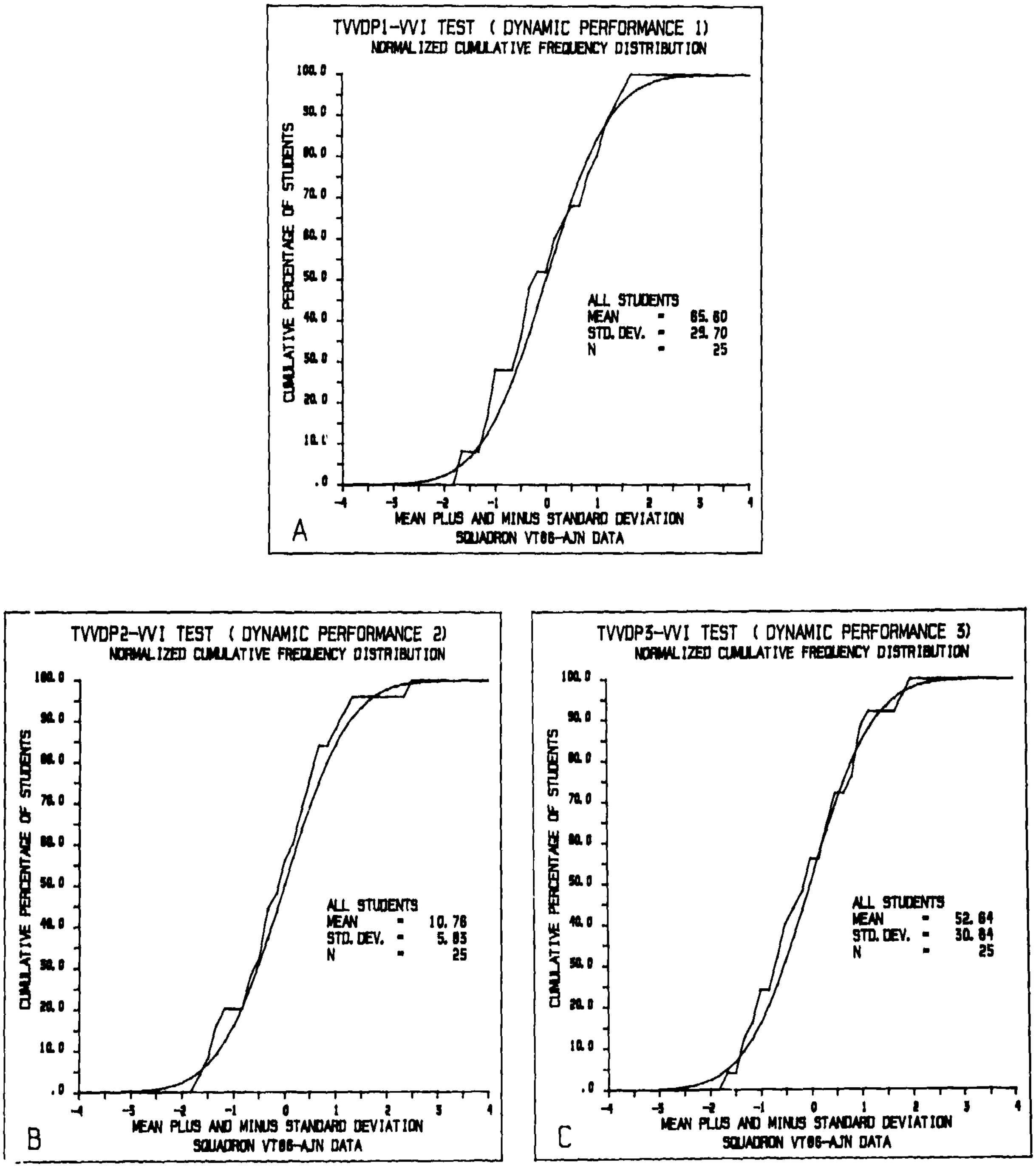


Figure C9

Normalized cumulative frequency distributions of three static performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

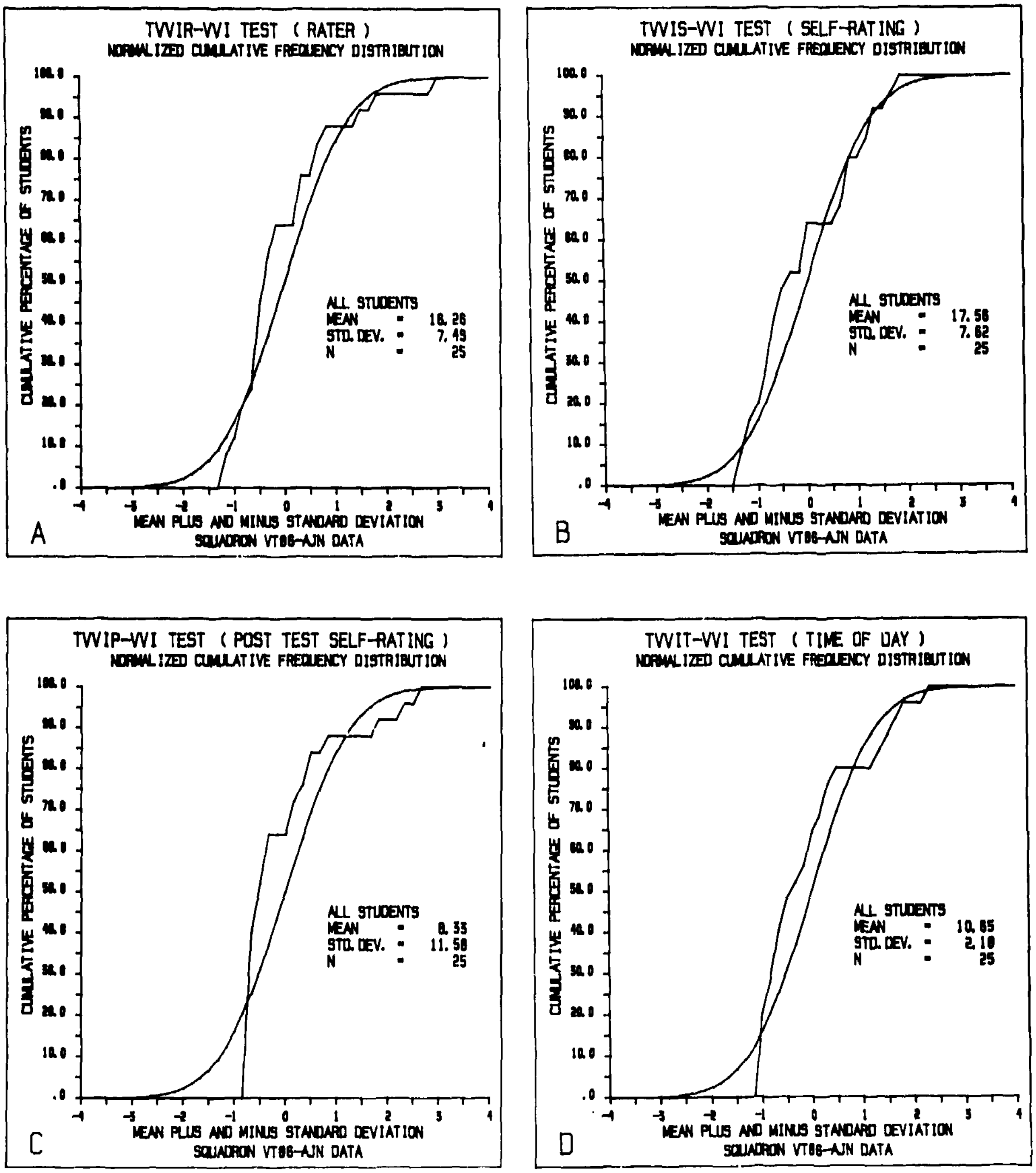


Figure C10

Normalized cumulative frequency distributions of the three dynamic performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

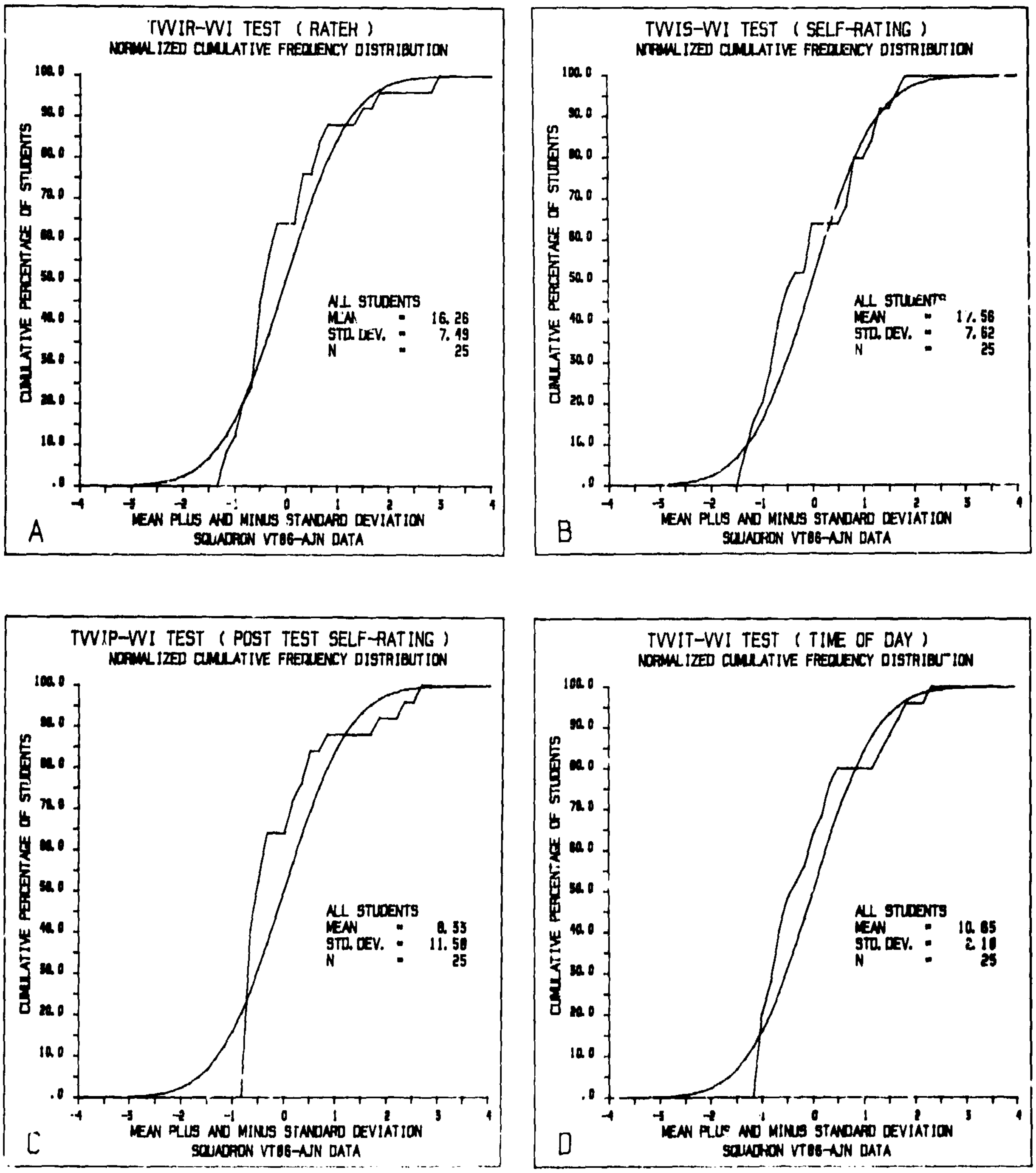


Figure C11

Normalized cumulative frequency distributions of the Visual-Vestibular Interaction Test (VVIT) scores (irregular curves) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NAMRL-1267	2. GOVT ACCESSION NO. AD-A088 105	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Airsickness during Naval Flight Officer Training: Advanced Squadron VT86-AJN		5. TYPE OF REPORT & PERIOD COVERED Interim 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) W. Carroll Hixson, Fred E. Guedry, Jr., Garry L. Holtzman, CDR, MC, USN, J. Michael Lentz, and Patrick F. O'Connell, CAPT, MC, USN		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Aerospace Medical Research Laboratory and Naval Aerospace Medical Institute Naval Air Station, Pensacola, Florida 32508		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS MF58.524.005-7032
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16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Mr. Hixson and Drs. Guedry and Lentz are with the Naval Aerospace Medical Research Laboratory; Captain O'Connell is with the Naval Aerospace Medical Institute; and Commander Holtzman is currently assigned to the USS Dwight D. Eisenhower, CVN-69, FPO New York 09501.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Naval aviation; Aviation medicine; Naval Flight Officers; Basic training; Aircrew performance; Attrition; Airsickness; Motion sickness; Biomedical tests

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is the second in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer training program. Flight data from 1,833 hops flown by 134 VT86-AJN students being trained for various weapon operation and navigation duties in attack and antisubmarine warfare aircraft indicate that approximately 55 percent of the students reported being airsick on one or more flights, 28 percent reported vomiting on one or more flights, and 30 percent considered

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their flight performance to have been degraded by airsickness on one or more hops. Of the total number of hops flown, airsickness, vomiting, and performance degradation were reported to have occurred on 8.6, 3.7, and 3.4 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Hixson, W. C. 1980
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: ADVANCED SQUADRON VT86-AJN. NAMRL-1267. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 6 May.

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This report is the second in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer training program. Flight data from 1,833 hops flown by 134 VT86-AJN students being trained for various weapon operation and navigation duties in attack and antisubmarine warfare aircraft indicate that approximately 55 percent of the students reported being airsick on one or more flights, 28 percent reported vomiting on one or more flights, and 30 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the total number of hops flown, airsickness, vomiting, and performance degradation were reported to have occurred on 8.6, 3.7, and 3.4 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

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Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
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Motion sickness
Biomedical tests

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